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CONTENTS.

Editorial 551
The Requirements of High Speed and Heavy Electric Traction 552
Optics and Theory of Ions, by P. Zeeman 555
Preliminary Note Upon the Broadening of the Sodium Lines by Intense Magnetic Fields, by A. St. C. Dunstan, M. E. Rice and C. A. Kraus. 556
Meeting of the International Society of Electricians 556
Electric Elevators—V 557
National Academy of Sciences, Washington Meeting 561
Fifth Annual Report of the General Electric Company 562
Digest of Current Electrical Articles, compiled by Carl Hering 563
Book Review 566
Magnetic Blow-out Lightning Arrester 567
A New Kind of Loose Pulley 567
A New High Insulating Porcelain Bushing 567
A New Telephone Desk-Set 567
Portable Voltmeter 567
All-China Junction Box and Motor Cut-out 568
An Instantaneous "Make and Break" Safety Knife Switch 568
A Handy Drill Case 568
Departments:
Financial Intelligence 569
Special Correspondence 569
General News 572
Personal Notes 572
Obituary Note 572
Trade and Industrial Notes 572
Business Notice 573
Illustrated Record of Electrical Patents 573

HIGH SPEED AND HEAVY ELECTRIC TRACTION.

The next great field of electrical engineering will probably be the adaptation of existing steam railroads for electric service. Already there are certain suburban railways using electricity for fast passenger service where steam has been hitherto considered the only available motive power, and several instances where the electric motor has been put to work hauling freight cars. Interest in the subject is very general, and the discussion of ways and means for the application of electricity in such service is bringing out a number of suggestions which will take form later in practical use.

The paper by Messrs. Hayward Cochrane and E. J. Swartout, abstracted in this number, presents some highly interesting information and noteworthy comparisons of existing types of locomotive mechanisms, both steam and electric. These authors, however, proceed upon the assumption that such electric traction as they discuss should follow the methods of steam traction now in vogue, each train being hauled by an electric locomotive or car containing the necessary motor apparatus, while the remainder of the train is for passengers or freight only.

It is doubtful if this be the best method under all circumstances. As long ago as 1886 Mr. F. J. Sprague advocated the use of motors on each truck—or at least upon each car of a train—the whole to be controlled from one point by some simple system of manipulation. This system seems to possess advantages of flexibility and freedom from weakness greater than any other. While it is not likely that its efficiency could reach so high an average as that of the single large motor system described, it is certain that its availability will be greater, while on light loads its efficiency may be comparatively very high. It is gratifying to know that Mr. Sprague will have the opportunity to put this method to a practical test in the equipment of the South Side Elevated Railway in Chicago.

There is no doubt that long lines cannot be operated economically by a direct-current system. At the same time, it is to be doubted if any form of alternate or multiphase current motor now in the field lends itself to the demands of traction service. The method proposed by Messrs. Cochrane and Swartout, contemplating the installation of a rotary transformer on each locomotive, with direct current motors on the axles, seems to be a practical suggestion. The efficiency of such a system could not be very high, when the loss in three transformations is reckoned.

Efficiency, however, in this instance should include availability. Given a system of transmission practicable over distances of a hundred or more miles, with an efficiency of only 50 per cent., it might be more available for railway purposes than a more efficient system which would be limited in range. Such a long-distance system would permit the installation of the generating station in the most economical situation, would frequently allow the use of water powers otherwise unavailable, and in many sections would be able to utilize coal at the mines. The cost of delivered power under these circumstances might be brought very low, and well within the limits imposed by competition with steam-operated roads.

AN OBJECT LESSON IN URBAN TRANSIT.

On April 27 the mausoleum in Riverside Park, New York City, under which the remains of General U. S. Grant repose, was dedicated with imposing ceremonies by President McKinley. The United States army and navy, the navies of foreign countries, militia from many States and a vast contingent of patriotic and other societies paraded, while the number of visitors to the city was estimated at little less than six hundred thousand. All these, and innumerable citizens, sought transportation to the scene of the ceremonies or vantage points from which to view the parade, and the consequence was an utter and lamentable failure of the west-side system of transportation of the city.

Officials of the Manhattan Elevated Railway state that that company alone carried over one million passengers on the day of the dedication. If their trains could have been kept in motion all the time it is almost certain that they could have carried twice as many. As it was, trains that started from the Battery at thirty seconds headway soon became blockaded, and more than once such a blockade extended for sixty streets, or three miles. The average time from downtown points to 125th Street seems to have been about an hour and a half.

A similar state of affairs obtained on the surface roads. The crowd at one transfer station was so great that the police reserves had to be called out to prevent accidents. Two-car trains were run at fifteen seconds headway on some of the cable lines, but even this was inadequate, and several hundred thousand persons at least must have walked to and from the park where the exercises took place.

It is to be hoped that the discomforts and dangers of those who had to make use of the inadequate facilities afforded by the various traction systems of the city on that day will prove an incentive to hasten the installation of some really efficient system of transportation in this city. If the elevated railroads had been provided with electric motive power, there is no doubt that the prompt starting of trains from stations would have avoided much of the delay. It has already been publicly stated that the Broadway cable system has reached its limit. Possessing no flexibility it cannot stand an overload. The contrast between the handling of great crowds in other cities and New York should certainly stir the civic pride of those who are in a position to provide adequate means of transit.

ZEEMAN'S DISCOVERY.

The curious discovery of Dr. Zeeman, that the lines of metallic spectra are broadened when the source of the radiation is in a magnetic field, is beautifully verified by the experiments of Messrs. Dunstan, Rice and Kraus, described by them in this issue. It is quite probable that the interferometer will find other uses in research upon the complex problems of molecular motion and radiation.

The suggestion of a new method of studying the saturation time of iron magnets and the reactance lag in electrical circuits by means of this instrument is ingenious, and seems to contain a most practical idea, susceptible of much development. The desideratum of an index of change in the condition of the magnetic field, which shall possess no inertia, is attained by the use of this method, and its seemingly easy adaptation to stroboscopic methods, should commend it to investigators of the phenomena in question.

It is not in its practical aspects, however, that Zeeman's discovery is so important. Its bearing upon the theories of light and other forms of radiant energy, and magnetism, is its chief value. It is too early to speculate upon the probable outcome of this discovery, but it is certain that it upholds Lorentz's theory of electrical phenomena and makes it seem the most logical.

AN IMPORTANT DECISION.

The recent decision of Judge Showalter, of the United States Circuit Court, in Chicago, that certain special legislation concerning street car fares in Indianapolis is unconstitutional, is of the greatest importance, and establishes a precedent which may become of wide application. The law in question set the legal rate of car-fare in Indianapolis at three cents instead of five. An injunction was prayed by the railway company affected, and issued on the ground that such legislation was destructive of a vested property right.

For several years street railways have been regarded as the legitimate prey of municipal bodies and legislatures. Taxed at every opportunity, and restricted as they are by specific ordinances and legislation, the movement to further burden them by the reduction of the time-honored and universal rates of fare has grown to considerable proportions in some quarters. It is cause for congratulation that this has received a check in Judge Showalter's decision.

It is likely that this movement, if unchecked, would have been a step in the direction of municipal ownership of street railways. Already this is advocated by certain economists, though the grounds of public utility upon which their arguments are based seem, in the light of the universal municipal extravagance which characterizes our cities, to be poorly chosen. The experience of municipalities with gas works and other such plants should be a warning to those who are agitating for such ownership of transportation facilities

REFRACTION AND DIFFRACTION OF RÖNTGEN RAYS.

At the recent meeting of the National Academy of Sciences, Professor Arthur W. Wright, of Yale, presented some experimental data upon refraction and diffraction of Röntgen rays, of which an abstract appears in another column. The results obtained in his experiments are such as might be expected, if the assumption that these radiations are of very short wave length is granted.

If it is assumed that these rays are due to undulations of wave lengths comparable to molecular dimensions, which is the current supposition in regard to them, there seems to be no reason to suppose them incapable of diffraction, while their absorption by substances of great density and their apparent absence of refrangibility are evident consequences. There certainly seems no evidence, so far, to warrant the belief that their character is different from that of other forms of radiant energy except in the item of wave length.

PHYSIOLOGICAL EFFECTS OF HIGH FREQUENCY CURRENTS.

The recent communication by M. d'Arsonval to the Société Internationale des Electriciens concerning the therapeutic and physiological effects of high frequency currents is highly interesting. It appears that the effects of such currents upon the human body are to profoundly modify the oxidation rate of the tissues, without producing any noticeable action upon the nerves of sensation. The conclusion, therefore, that these currents are confined to the surface of the body and produce only superficial effects, seems to be untenable.

From further experiments it appears that high frequency currents are fatal to certain noxious microbes and bacilli. Whether or not this is due to a stimulation of oxidation in these organisms is not stated by M. d'Arsonval, but such a belief seems warranted from the known effects of oxygen upon them and the great augmentation of oxidation in the human subjects experimented upon. The conclusion of the research will be awaited with great interest by many to whom it holds out a promise of a new means of treatment for zymotic disease.

The Requirements of High Speed and Heavy Electric Traction.

At a recent meeting of the Chicago Electrical Association Messrs. Hayward Cochrane and E. J. Swartout presented a paper on the "Requirements of High Speed and Heavy Electric Traction." The paper consisted mainly of an outline of the writers' opinions concerning the most practical results possible in this direction. After reviewing the history and literature of the subject to some degree, the requirements of draw-bar pull and tractive power were discussed, and the necessities for an electric locomotive capable of hauling suburban trains at high speed were set forth. A comparison between the tractive power and the adhesive power of the two and four motor equipped cars of the Metropolitan Elevated Railway of Chicago and the Chicago, Rock Island & Pacific steam locomotives was instituted.

"Assume twelve coaches as the maximum train hauled by this locomotive, and seven coaches as an average train, and speeds of thirty miles per hour. Total weight of engine and tender = 194,700 pounds. Weight of drivers, 107,000 pounds; twelve coaches loaded at 58,400 pounds, 700,800 pounds; total train weight, 895,000 pounds, or 447¾ tons. With a seven-coach train, at 58,400 pounds each, the total is 408,800 pounds, plus engine and tender, 194,700 pounds, 603,500 pounds, or 301¾ tons. The formula used by Mr. G. F. Wilson, superintendent of motive power for the Rock Island road, for obtaining the tractive power of locomotives is $T = \frac{D^2 \times P \times S}{W}$ lbs., where D is diameter of steam cylinders in inches; P is mean effective steam pressure, 85 per cent. of boiler pressure; S is length of stroke in inches; W is diameter of drivers. For the above suburban engine $D = 18''$; $P = (160 \times .85 = 136)$; $S = 24''$; $W = 63.75''$. Substituting, we have $T = \frac{18^2 \times 136 \times 24}{63.75} =$ 16,588 lbs. Allowing 10 per cent. for friction losses, $T = 14{,}929$ lbs.

"The adhesive power of the locomotive upon ordinary rails must greatly exceed the tractive power, because the rails may be wet or slippery at times. An English rule for obtaining the adhesive power of a locomotive is as follows: With dry rails, allow 600 pounds per ton of weight on drivers; with very wet rails, allow 550 pounds; with ordinary rails, 450 pounds; with misty weather, rails greasy, 300 pounds, and with rails frosty or snowy, 200 pounds. Assuming 450 pounds per ton, the above suburban locomotive would have an adhesive power $A = 107{,}000 \div 2{,}000 \times 450 =$ 24,075 lbs., or about 61 per cent. greater than the tractive power.

"Assuming that each loaded coach of a Chicago, Rock Island & Pacific suburban train weighs 58,400 pounds, and twelve coaches to be the largest train, the total train weight would be, including locomotive and tender, 895,000 pounds, or 447¾ tons. The tractive power being 14,929 pounds, there is a tractive power per ton of train of 33.3 pounds. For a seven-coach train weighing complete 301¾ tons, the tractive power per ton is 49.4 pounds. With an elevated railway train of two coaches and one motor car equipped with four motors equal to a total weight of 77 tons, where the motor car loaded weighs 70,000 pounds, or 35 tons, adhesive power is $35 \times 450 = 15{,}700$ pounds, but the tractive power of each motor at a speed of 20 miles per hour is about 2,700 pounds, or for four motors 10,800 pounds. The adhesive power is therefore about 45 per cent. above the tractive power, which is lower than for the Rock Island suburban engine. The tractive power per ton of train is 140 pounds, or greatly in excess of that for the Rock Island trains. For an elevated railway two-motor equipment, assuming a loaded motor car to weigh 63,000 pounds, with two loaded coaches, each of 42,000 pounds, or a total train weight of 147,000 pounds, or 73½ tons, the tractive power would be that of two motors of 100 horse power each, 27,000 pounds drawbar pull, or 5,400 pounds. Assuming the weight of motor car on drivers to be 35,000 pounds, we have the adhesive power equal to $35{,}000 \div 2{,}000 \times 450 = 7{,}875$ pounds, or about 45 per cent. more than the tractive power. The tractive power per ton of train is 73.4 pounds. For an elevated train of one motor car, loaded, equipped with two motors, and three loaded coaches of 42,000 pounds each, the total train weight would be 189,000 pounds, or 94½ tons. The tractive power would be 5,400 pounds, and the adhesive power 7,875 pounds. The tractive power per ton of train would be about 57 pounds, which is low for a service where the stops are so frequent. The adhesive and tractive power per ton of train should be much greater for frequent stopping than for a suburban service like that of the Rock Island road, where there are but four or five stops in 8 miles. The motors used on suburban railways should be linked to both axles, so that the whole weight of the motor car would be effective in giving adhesive power. The motors, moreover, should be designed for a much greater weight per horse-power, and since the trucks are crowded with them as they are now built, larger drivers as well as slightly longer trucks would probably be required. If the motors were designed with a greater weight per horse-power they would be less likely to heat seriously when run continuously under full load. It would be advisable, moreover, to have upon the motors a commutated field winding for use in connection with the series-parallel method of control, such that a greater number of safe and fairly economical running speeds could be had in place of the two running points of the present series-parallel controller. Running in series may give too slow a speed, while running in parallel may give too fast. If, however, the motorman can have the option of about six running speeds, it would be much easier for him to keep on schedule time. By having heavier motors per horse-power and more running points, the acceleration and running of trains would be accomplished far more economically and satisfactorily than at present. The passenger coaches and trucks need not be any heavier than now built, and might be considerably lighter. The double spring suspension of motors should be adopted, as tending to prolong the life of rolling stock and of rails not case welded."

Wherever the third rail is used it should be protected by guards, so that track men would be comparatively safe while discharging their duties. A form of trolley rail was shown, which was considered by the writers better than the present form for use with high guards. Its design was such as to obviate the lodging of snow in winter, and at the same time to provide for easy support and inspection. The cast welding of the rails was strongly advocated, and, if necessary, expansion joints could be used at proper distances in this form of construction. Where these joints are used the rails should have a special section, so that each should be equal in cross-section to the standard form.

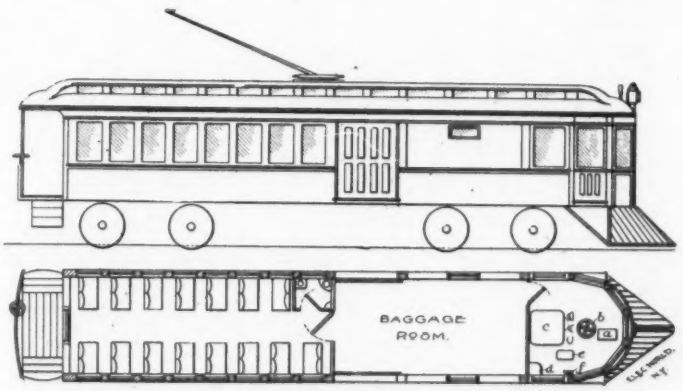


FIG. 1.—PLAN AND ELEVATION OF CAR.

The motorman's cab should be arranged as follows: His seat should be from 4 to 6 feet back from the front window (this distance being easier for his eyes) and at the right-hand side of the cab. A sliding window should be placed by his seat to enable him to look out easily upon the track or the train whenever necessary. The painting of the cab should be dark, so as to relieve the motorman's eyes from all glare. The controller should be operated by a horizontal lever, instead of a crank, the lever being arranged with a dog engaging in notches, which give the required speed combinations.

The arrangement of partitions should be about as shown on the plan of Fig. 1 for suburban and small cross-country roads, where the motor car is used for baggage, express, mail and smoker. For a road operated by direct current, it would be a nice arrangement to have the lights, and possibly the heaters, in each car fed from independent groups of storage cells. In case the train became stalled from failure of power circuit, the lights at least could be kept on for a considerable length of time, probably until the power circuit was put into working condition again. By charging batteries in series and connecting lights to groups at lower voltages there would be greater safety in controlling them, and they would be less subject to flickering than in the case of present man-

ner of connecting. By having skilled motormen, a saving in energy used to accelerate trains could be effected, and the item of depreciation of rolling stock reduced to a minimum. The speed attained by elevated and ordinary suburban trains is about 30 to 35 miles per hour maximum, which is doubtless high enough for frequent stopping. For express suburban service, however, considerably higher speeds, say of 40 to 45 miles per hour, might be advisable. For suburban service it would seem best to use elevated or partially elevated track in city limits, with no grade crossings, and a third rail trolley, but for the suburbs to have the overhead trolley, since it would be impracticable to use the third rail where there were street crossings at grade. We are informed by the Walker Manufacturing Company that one of their 32-ton motor cars, equipped with four 50-hp motors hauled six open coaches, each of 10 tons, at a speed of about 30 miles per hour, the total load upon the motor car and coaches being 670 persons. An ordinary trolley with No. 00 trolley wire was used and gave very satisfactory working. The total weight of empty motor car and coaches was 184,000 pounds, and assuming 150 pounds per passenger, the total load was 105,000 pounds, or a load per car of 15,000 pounds. The total train weight would therefore be 284,000 pounds, or 142½ tons. Assuming a tractive power of 27 pounds per horse-power of motors, or 5,400 pounds for the four motors, the tractive power per ton of train was 37.6 pounds, or a little in excess of that for the largest Rock Island train, while the adhesive power was 14,400 pounds or 166 per cent. of the tractive, or a trifle in excess of that for the Rock Island locomotive or the elevated railway motor cars.

For heavy suburban service, assume a train of five closed coaches hauled by a motor car equipped with 250-hp nominal capacity, either four motors of 62½ horse power, one to each axle, or two motors of 125 horse power linked to pairs of axles, so as to obtain the full adhesive weight of the motor car, all its weight then being upon the drivers, and therefore effective weight. If closed coaches of 32,000 pounds were used, five loaded coaches would weigh 210,000 pounds or 105 tons, but the six loaded coaches of the Walker train weighed 103 tons, assuming one-seventh of the total number of passengers to be in each coach. We may therefore assume for a heavy closed car train of five coaches a motor car of about 35 tons, or 70,000 pounds, this plus a load of 10,000 pounds, or 5 tons, makes a total train weight of 145 tons. Assuming an approximate tractive power of 27 pounds per horse power gives 6,750 pounds as the tractive power of the suburban motor car. Assuming an average weight of motor car of 37 tons, we have an adhesive power of 16,650 pounds, or 146 per cent. of the tractive power. With a direct-power system working at 500 or 600 volts pressure—say 600 volts (which would probably be best for any ordinary length of suburban road of about 15 miles, not over 20)—a current of about 440 amperes would be required for the full rated capacity of the motors. On starting the train a much larger current would be called for under ordinary conditions, a current which would be excessive for passing through such contact surface as would naturally obtain with the trolley wheel.

To obviate this difficulty we suggest the use of a trolley shoe. This could be made of a mixture of plumbago and carbon, and used with success against ordinary hard-drawn copper trolley wire. The upward pressure of such a shoe need be no greater than that now employed with the trolley wheel.

For short cross-country railroads of 30 to 60 miles length, with light traffic, and for long trunk-line roads, it would seem almost out of the question to use the direct-current system. The ideal for such lines would be the alternating current, complete from generating station to car axle. At the present time, however, there seems to be no practical method of operating such a system. In order, therefore, to operate successfully such roads, taking into consideration the cost of installation and interest thereon, one of two lines of engineering should probably be proceeded upon. In either one the use of the alternating current at a pressure of 10,000 to 20,000 volts with step-up and step-down transformers for transmission from a central generating station to sub-stations at intervals along the line, for roads 30 to 100 miles long would be used. One plan would be to place at each sub-station static and rotary transformers which would furnish direct current to sections of the road not over 15 miles long at a pressure of 500 to 700 volts, and use a single trolley and rail-return circuit. The other plan would be to have the sub-stations further apart than in the former case, and to install in each one a bank of static transformers which would deliver an alternating current of 1,000 to 2,000 volts to double or triple trolley wires of small cross-section; then to have upon each motor car or locomotive a rotary transformer of a capacity ample for any demand made upon the motors, which would receive direct current from it at 500 volts pressure. The efficiency of fully loaded static or rotary transformers is high, and is very good at medium loads. By using this system, also, a special method of control might be employed. In connection with series motors, use the series-parallel-commutated field method as previously herein suggested, and if greater ranges of speed were desired it might be practicable to vary the field strength of the generating side of the rotary transformer by means of a rheostat. The controller lever should have a catch or dog, engaging with notches in a quadrant, similar to the reverse lever of a steam locomotive. By placing both static and rotary transformers in the sub-stations, the cost of copper for sub-feeders at 500 volts for a road of any considerable length would be enormous; besides, there would be extra cost for attendance at sub-stations, and in considering such an outlay the probable business to be done by the road would have to be carefully estimated. For heavy trains and very high speeds, moreover, Mr. Wm. Baxter, Jr., estimates that electric locomotives should have a maximum horse-power of at least 1,250. This on a 500-volt circuit would call for more than 2,000 amperes, and would necessitate an extremely heavy overhead construction if a trolley were used. If the third-rail system were used, there should be no street crossings at grade, and in countries where snow falls there would be an endless amount of trouble at times with the third rail on account of drifting. By placing the rotary transformers on the locomotives and having a pressure on the trolley wires of 1,000 to 2,000 volts, it would be necessary to insulate specially the conductors leading from the trolleys to rotary transformer from the frame of the locomotive, which fact would almost prohibit the use of the rails at one side of the circuit. The tri-phase alternating system seems to be better suited to this class of work than the single or two-phase system, because it would save about 25 per cent. of the copper necessary for the former system. The trolley wires and feeders could be of comparatively small cross section, so that the overhead construction need not be extremely

COMPARISON OF VARIOUS SUBURBAN LOCOMOTIVES.

	Total Weight of Engine and Tender.	Weight of Engine.	Weight on Drivers.	Weight on Truck.	Weight of Tender Loaded.	Weight of Tender Empty.	Diameter of Drivers.	Size of Cylinder.	Steam Pressure.	Mean Effective Pressure in Cylinder.	Theo. Tractive Power.	10 Per Cent. off for Friction.	Ratio of Adhesive to Tractive Power App	Dead Wt. per Lb. of Tractive Power.	Type of Engine.	Class of Service.	HP of Elec Locom. of Same Wt. on Drivers.	App. Useful Weight for Total Engine.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Ins.	Ins.	Lbs.	Lbs.	Lbs.	Lbs.						Per Ct.
C., R. I. & P.	203,000	125,000	83,000	42,000	78,000	28,667	78	19½ × 26	190	161½	20,470	18,423	1—1	4—1	8 wheel'r	Express	758	40
St. Clair Tunnel.	195,000	195,000	195,000	....	....	....	50	22 × 28	160	136	36,861	33,175	1.2—1	....	10 "	Tunnel	1365	100
C., R. I. & P.	194,700	126,700	107,000	19,700	68,000	....	63¾	18 × 24	160	136	16,588	15,929	1.6—1	3—1	6 coupl'd	Suburban	614	54
C., C., C. & St. L. (Schen)	216,000	126,000	83,000	43,000	90,000	40,000	72	19 × 24	200	170	19,433	17,490	1—1	5—1	8 wheel'r	Express	719	38
L. S. & M. S. (Schen).	205,133	118,000	90,000	28,000	87,133	40,800	68	18 × 24	190	161½	18,468	16,621	1.25—1	4—1	10 "	"	684	43
B. & O. Tunnel.	192,000	192,000	192,000	....	....	....	62	.....	....	....	.. .	38,880	1.1 - 1	....	8 "	Tunnel	1440	100
B., C., R. & N. (Brooks).	221,000	137,000	108,000	29,000	84,000	37,667	69	18 × 26	180	151	18,435	16,591	1.5—1	4—1	10 "	"	682	48
C. & E. I. (Schen).	171,000	109,000	95,000	14,000	62,000	....	63	18 × 24	150	127½	15,737	14,163	1.5—1	3—1	6 coupl'd	Suburban	582	56
C. & E. I. (Schen).	121,000	75,400	61,700	13,700	45,600	....	57	17 × 24	150	127½	15,515	13,963	1—1	2—1	4 "	"	574	50
Vandalia (Pittsburg).	223,400	142,000	127,000	15,000	81,400	34,067	62	20 × 26	185	157¼	26,393	23,754	1.2—1	2—1	Mogul	.....	977	56
Metrop'n Ele- { 2 motors.	63,000	....	85,000	.	...	....	33	.....	....	....	....	5,400	1.4—1	5—1	.....	.....	200	55
vated (Elec.) { 4 motors.	70,000	....	70,000	....	....	....	33	.....	.	....	....	10,800	1.4—1	....	.....	.....	400	100

heavy, though it would of necessity be quite complicated. While the double and triple trolley systems would have many objectionable features, yet they seem to offer at the present time about the best solution for the conducting system of long-distance electric traction. In planning the static transformer sub-stations it would be well to install at alternate stations a duplicate or relay transformer bank, so that in case any working transformer bank became disabled it could be cut out and the relay cut in temporarily. The pole line should consist of iron pole construction, and the erecting and spacing of distances should follow the plan of the best street railway installation, except that specially designed double insulating trolley wire hangers and feeder wire supports should be used. The locomotive should be provided with an electric brake as well as an air brake for very high speed service, as an extra factor of safety; a brake similar to that of the Sperry design might be employed.

The arrangement of the locomotive cab for a combination baggage and smoking car is shown in plan view in Fig. 1. The rotary transformer, *C*, is shown slightly to the left of the centre line of car and at the rear of the cab opposite the motorman's seat. His seat, *D*, is close by a sliding window, similar to that of a steam locomotive. The controller, *E*, is at his left, and slightly to the front and close to the rotary transformer. The air-brake valve, *F*, is in front of the motorman and close to the side of the car. The hand brake, *B*, is close to the controller at the front and left. The air pump, *A*, is in front and slightly to the right of centre line of car, so as to counterbalance, with the weight of controller and rheostat frames, which are not shown, the position of the rotary transformer.

For heavy trunk-line work an independent locomotive should be used, in which case the rotary transformer should be placed at the middle, and the air pump and rheostat frames disposed so as to counterbalance the weight of the controller, which could be at one side. By not using the rails for one side of the power system, an electric block signal system could be employed, which would automatically stop a train in block No. 1 if block No. 2 were not clear.

Each train should be provided with a hand telephone, and the line supplied with a metallic circuit, with branch blocks about eight to a mile, so that disabled trains could easily get assistance from the nearest station, using the batteries at that station for telephoning. Terminal facilities in large ities could be supplied by 500 volts direct current on the single trolley or third-rail system, and if the tracks were partially or wholly elevated, as they should be, this plan would work very nicely.

Optics and the Theory of Ions.*

BY DR. P. ZEEMAN.

It is well known that, when submitted to the action of a magnetic field, bodies ordinarily isotropic become double refracting. This property disappears when the magnetic influence ceases. Kerr, who discovered this phenomenon, also established the fact that the plane of polarization of a ray of monochromatic light was deviated when the ray impinged upon the pole of an electromagnet.

The experimental analysis of these facts led me to inquire if the magnetic field could also modify the nature, that is, the vibration period, or the spectral position, of monochromatic light emitted by a flame. Experiment responded affirmatively to this question.

Place the flame of an oxy-hydrogen burner between the poles of a Ruhmkorff coil, and introduce into this flame a filament of asbestos saturated with sodium chloride solution. Produce by means of a Rowland grating the spectrum of the flame, first observing it in the absence of any magnetic field, and then while the coil is in operation. It will be seen very clearly that when current passes in the induction apparatus the two D lines of sodium are broadened.

Does this phenomenon result from an alteration in density and temperature of the sodium vapor in the magnetic field? I think this interpretation is made inadmissible by the following experiment:

I strongly heated fragments of sodium in a very large porcelain tube, so as to diffuse the vapor throughout the tube. The tube was closed at each extremity by a stopper of glass with plane parallel faces of one square centimetre area. Placing this in a horizontal position between the poles of an electromagnet perpendicularly to the lines of force I passed through it a beam of light from an electric arc lamp. The absorption spectrum then showed the two D lines of sodium. By means of a clockwork mechanism I kept the tube constantly turning about its axis, to avoid variation of temperature. Immediately upon the operation of the electromagnet the D lines showed an evident broadening. There can be no other conclusion than that the vibration period of sodium light is affected by the magnetic field.

In 1862 Faraday made the first researches of this kind of which the history of science makes mention. It is remarkable that he reached a negative result, though the resources at his command were very insufficient.

What led me to suspect this conclusion of Faraday's was the consideration of the accelerating and retarding forces in play between the atoms and the molecular vortices of Clerk Maxwell, in connection with experiments upon the magnetization of spectral rays. The examination of these systems led me to refuse the rejection, as an *a priori* impossibility, of the modification of the vibratory period. Finally, I was struck with the apparent anomalies of the example, suggested by Lord Kelvin, of the combination of a very rapidly rotating system and a double pendulum. The theory of electrical phenomena proposed by Professor Lorentz always seemed to me to be the logical direction in which to seek for the explanation of the observed phenomena.

This theory shows the small molecular elements of all bodies charged with electricity—the *ions*—and connects all electrical manifestations with the equilibrium or the movement of these ions. It is natural to think that in the magnetic field the forces which act directly upon the ions should suffice to produce the broadening of the lines.

M. Lorentz, to whom I submitted this interpretation, had the kindness to explain to me how the movement of the ions could be calculated. He also called my attention to the point that if the application of his theory is proper in this case, two consequences result:

1. The light emitted by the edges of the broadened lines should be circularly polarized in the direction of the lines of the magnetic field.

2. The amount of the broadening should permit the determination of the ratio $e \div m$ between the electric charge of the ion, e, and its mass, m.

Experiments which these assumptions led me to make have fully confirmed them. By means of a quarter-wave plate and an analyzer, I found that the edges of the magnetically broadened rays emitted light circularly polarized in the direction of the lines of force, and rectilinearly in a perpendicular direction. These facts appear to clearly manifest the real existence of ions. Furthermore, the approximate measurement of the ratio $e \div m$ gives 10^7 as its order of magnitude, when e is expressed in electromagnetic units. I take this opportunity to thank M. Onnes, director of the Physical Institute at Leyden, for the interest he has taken in my research.

* *Revue Générale des Sciences*, April 15, 1897.

National Electric Light Association Meeting.

Arrangements have been made by the secretary of the National Electric Light Association with the International Hotel and Cataract House, at Niagara Falls, for the accommodation of members and delegates attending the twentieth convention on June 7, 8 and 9. The headquarters and convention hall will be at the International Hotel. Both hotels have made substantial reductions in their rates, and floor plans of both may be seen at the headquarters of the association, 136 Liberty Street, New York. As already announced, there will be no exhibition of supplies and apparatus under the auspices of the association, but every facility will be afforded to individual exhibitors to display goods in their own way, and the association will provide whatever power is necessary for the operation of working apparatus. There is every indication that there will be a large number of exhibits, judging from the inquiries received at headquarters. Everything points, too, to a very large attendance, and a very successful meeting in every way. An unusual amount of interest seems to be taken in this convention by the members. They are making inquiries and arrangements with unusual alacrity, and they seem to be in entire harmony with the spirit of the association's enterprising and progressive president.

Preliminary Note Upon the Broadening of the Sodium Lines by Intense Magnetic Fields.

BY A. ST. C. DUNSTAN, M. E. RICE AND C. A. KRAUS.

In view of the importance from a theoretical standpoint of the discovery, by Zeeman (*Phil. Mag.*, March, 1897), of the broadening of the sodium spectral lines by an intense magnetic field, it has seemed to the writers worth while to endeavor to investigate this result by a method differing from that used by the discoverer.

Zeeman used a concave grating, and simply observed that the spectral lines broadened when the source of light was subjected to the influence of an intense magnetic field. We have used Michelson's Interferometer, which is vastly more powerful than a grating for analyzing a single spectral line or a narrow group of such lines. The apparatus was arranged as shown in Fig. 1. The light was furnished by a bunsen flame, *A*, placed between the poles of a powerful electromagnet, *B*. A piece of asbestos saturated with NaOH solution was wrapped around the burner at the top. The light is rendered slightly convergent by the lens, *C*, and falls upon the semi-silvered surface, *D*, where part is reflected to the movable mirror *E* and part transmitted to the fixed mirror *F*. These two beams, reflected at the mirrors *E* and *F*, are

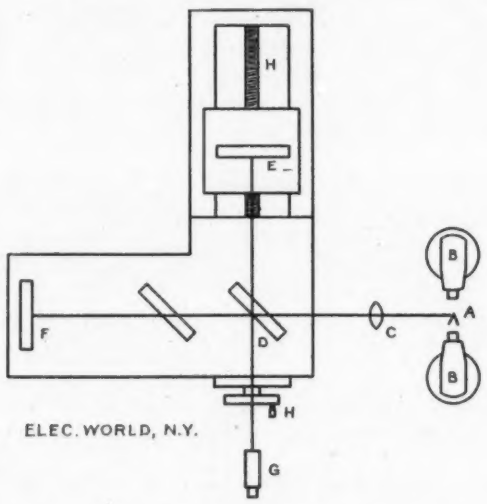


Fig. 1.—Sketch Plan of Apparatus.

re-united at the semi-silvered surface, *D*, the transmitted part of the former and the reflected part of the latter producing interference.

Under these conditions, with a telescope, *G*, focused for parallel rays, or with the unaided eye, the observer will see a series of concentric circular fringes.

If now the mirror, *E*, is moved away from the observer, by turning the screw, *H*, the difference of path of the interfering beams is increased, and the fringes become periodically more or less distinct or "visible," passing though successive maxima or minima.

The visibility is defined as the ratio between the difference of intensities of a bright and a dark ring divided by the sum of these intensities, or expressed algebraically $V = \frac{I\,\text{bright} - I\,\text{dark}}{I\,\text{bright} + I\,\text{dark}}$.

If now the visibilities at the maxima be observed for increasing differences of path, Michelson has shown that the curve formed by taking visibilities as ordinates and differences of path as abscissas approximates to that given by the equation $V = 2^{-\frac{x^2}{\triangle^2}}$, where V is the visibility expressed as a proper fraction, x is the difference of path of the interfering beams in millimetres; $\triangle$ is the difference of path at which V falls to half its initial value. He has further shown that the widths of spectral lines are inversely proportional to $\triangle$.

It is thus seen that the broadening of the sodium lines under the influence of a magnetic field would be indicated by a more rapid falling off in this visibility curve.

The curves obtained by the writers are shown in Fig. 2. No. 1 is the visibility curve obtained as above from the bunsen flame, the magnet not being excited; while 4 is the visibility curve when the magnetic field between the pole pieces was in the neighborhood of 12,000 (estimated) C. G. S. units. The other two curves were taken with weaker fields. The relative strengths of the fields were in the same order as the shortening of the curves.

It is thus seen that the two sodium lines are broadened by the most intense field about in the ratio of 1 to 1.7, and less with weaker fields.

The effect is very decided when a difference of path of 10 to 18 mm. is reached. The fringes are quite distinct with no magnetic

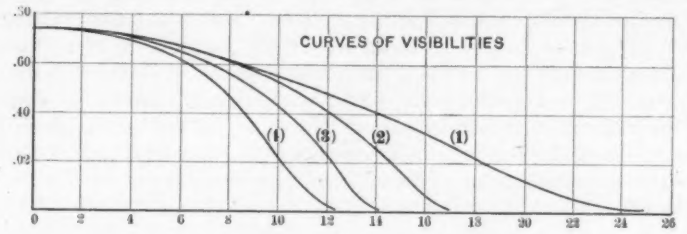


Fig. 2.—Curves of Visibilities.

field, but are almost entirely obliterated when the current is turned on.

No special adjustment of the apparatus is necessary beyond that ordinarily required to obtain clear fringes.

The visibilities given are uncorrected eye estimates, but the results are so decided that it seems worth while to record this confirmation of Zeeman's discovery.

One very interesting phenomenon was observed in connection with the disappearance of the fringes when the current was switched on to the magnet. The circuit containing the large magnet is of course highly inductive, and if an E. M. F. is suddenly applied to it a finite time is required for the current and consequently the magnetism to rise to its full strength. In the magnet used a little over one second is required to attain full saturation. The fringes do not disappear until this is attained, but simply become gradually less visible, thus revealing to the eye the growth of the current in the circuit.

It has occurred to the writers that in connection with a stroboscopic arrangement for viewing the fringes this apparatus would furnish an excellent method for determining the curve of the establishment of a current in an inductive circuit containing iron.

The writers are making a more careful series of experiments along this line, and hope soon to be able to communicate a fuller and more accurate set of results.

Meeting of the International Society of Electricians.

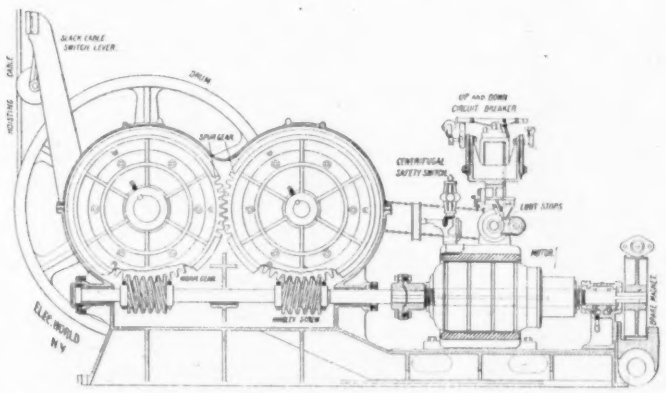
At the last general meeting of the International Society of Electricians, which took place on the 7th of April, 1897, the following officers were elected for the year 1898-99: President, R. V. Picou; vice-presidents, MM. Hillairet and Pollard; general secretary, M. Gosselin. M. Pellat presented a communication upon the contemplated decimal division of the hour in France, and pointed out the perturbations which would follow in the C. G. S. system if the propositions of the commission having the matter in hand are accepted. The society decided to take a stand upon the question, and to address a letter to the Government. M. d'Arsonval presented a paper upon the physiological and therapeutic action of high frequency currents. He showed the powerful inductive effects which can be obtained with these currents. A striking experiment consists of placing three lamps in tension and allowing the current to pass through the body. These currents exercise no action upon the nerves of general sensation, and a man placed in a circuit does not feel that he is traversed by the currents which brilliantly illuminate the lamps. The principal results of this electrification are an augmentation of the oxidations in the organism and an increase in the production of heat. A subject who, under ordinary conditions, eliminates 17 to 21 litres of carbonic acid per hour, throws off 37 litres after having been submitted to this action. High frequency currents do not act solely upon the surface of the body, but also profoundly upon the interior. All of these results have been observed upon a number of subjects by MM. Apostoli and Charrin. M. d'Arsonval cited, in closing, the action exercised upon microbes and bacteria by these currents. The microbes and bacilli are modified, and the toxines are killed and transformed to vaccine. MM. d'Arsonval and Charrin hope by this method to arrive at a direct treatment for the interior of the bodies of patients suffering with zymotic disease. Experiments to this end have been begun.

Electric Elevators.—V.

THE SPRAGUE DRUM-WINDING ELECTRIC ELEVATORS.

A very excellent line of drum winding electric elevators has been developed within recent years by the Sprague Electric Elevator Company. These machines are built in various styles and sizes, depending upon the particular purpose for which they are to be used. Both the gearing and electrical control apparatus differ in these different machines. The Sprague tandem worm-gear drum-winding elevator, for either passenger or freight service, is particularly notable among the various electric elevators built by this company, and embodies many peculiar features both in controlling apparatus and gearing.

Primarily, this machine consists of a large grooved winding drum mounted on a heavy shaft, which is supported between an outboard bearing at one end, and suitable bearings formed by the gear case at the other. The drum is operated by means of a duplex worm and interlocking spur gear arrangement, which is of particular interest. The motor, gearing and brake are mounted on a common base, having the motor and brake at one end, and the gearing at the other. All gearing is entirely enclosed in an oil-filled casing,

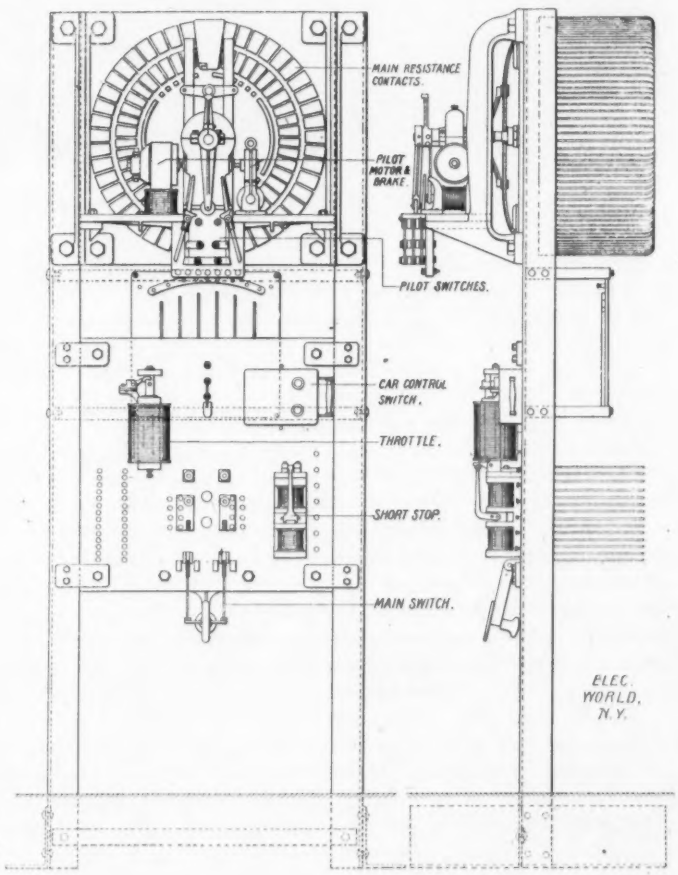


LONGITUDINAL SECTION OF DUPLEX-GEAR DRUM-WINDING ELECTRIC ELEVATOR.

the lower portion of which practically forms part of the base, while the upper cover can be lifted off for inspection. Fitted to the motor shaft, which extends through into the gear case, are two tandem Hindley screws with opposite threads. Each of these screws meshes into a combination worm-wheel, having on each side a spur gear. The furthest combination gear wheel is mounted on the drum shaft, while the inner wheel is mounted on a separate short shaft also running in a bearing fitted to the sides of the gear case. These combination gears are so arranged that the screws on the motor shaft co-act with the worm wheels, producing opposite rotation in them, while the double spur gears on both sides of each respective worm interlock. A great economical advantage is claimed for this type of gearing, which is primarily due to the duplex Hindley gear arrangement and interlocking spur gears. End thrusts on the screw shaft are not only eliminated, but by interlocking through the medium of separate spur gears instead of the worm wheels direct, additional economy and superior operation is obtained. The Hindley type of worm gear is generally well understood and scarcely need be described here. In general plan this method of gearing consists of a worm and screw gear combination in which the screw member is made concave and encircles the worm wheel over a small arc, making contact on all of the teeth included in the arc of contact. In this particular machine, by the use of this modified interlocking Hindley gearing, astonishing efficiencies have been produced.

The motor used in the drum-winding machine is of the iron-clad type, with four poles, and in general construction is similar to the screw elevator motor previously described. In this instance, however, the motors are shunt-wound only, this form of winding being used for various previously discussed reasons. The capacity of the motor is usually from 10 to 20 horse-power. The frame of the motor is bolted to the base, and the armature shaft is supported at the commutator end in a heavy bearing mounted on the base of the machine. It projects through this bearing and is fitted at the outer end with a wide-flange steel brake pulley. This brake pulley is gripped by two vertically placed concave wooden shoes, each fitted to a heavy iron lever pivoted vertically to a casting enclosing the brake coils. The upper or long end of each lever is fastened to a spiral spring tending to pull these ends together and bring the brake shoes tightly against the pulley. This spring is shown immediately above the pulley. The operating magnet below the pulley is entirely ironclad, being enclosed in the iron casting to which the levers are pivoted. It is very powerful and of peculiar construction, and acts on the two armature cores attached to the short ends of the levers. When energized, the magnet counteracts the action of the spring, releasing the brake shoes. The complete device forms a very perfect electric braking mechanism, operating easily in either direction.

As is usual with drum-winding machines, the motor of this machine operates in both hoisting and lowering and is connected to supply service under both conditions. Over-counterbalancing is resorted to in order to economize the energy consumed by the motor, the amount of over-counterbalancing weight being proportioned to the particular conditions under which the machine operates. This weight is hung from cables oppositely wound on the drum to the hoisting cables. For controlling and regulating the operation of this electric elevator from the car, electric pilot motor methods similar to those used in the screw and nut machine are employed. There are, however, several essentially different features embodied in the appliances controlling the main motor, in order to permit of operation in either direction, instead of when hoisting only. In general construction, the pilot motor, car switch, pilot switches and main resistances are almost exactly similar in both instances. The throttle and short-stop switches are also retained in this machine, but instead of the main and auxiliary circuit-breaker, up and down circuit-breakers are substituted,



CONTROL SWITCHBOARD FOR DUPLEX-GEAR DRUM-WINDING ELECTRIC ELEVATOR.

which are mounted upon the frame of the motor instead of on the switchboard. Automatic upper and lower limits, centrifugal governor, and slack-cable safety switches are also mounted on the motor frame. For the drum machine the control switchboard also consist of two panels, one mounted over the other, the upper panel containing the pilot motor and switches and the main resistance, while the lower panel contains the main switch, short stop, throttle, car-operating and throw-over switch and short-circuiting resistance. These controlling switchboards for each ma-

chine are made up in a similar fashion to the previously described switchboards, each machine having its separate controlling switchboard or panel, which may be mounted at any point in the vicinity of the elevator machine.

The main resistance is made up of the special iron composition and has an up and down section. In addition to the main resistance contacts on the face of the upper panel, there is an inner circle of contacts, which is connected to the shunt field of the main motor and field resistance. On the hoisting machine the upper and lower safety stop switch consists of a small screw shaft rotated by a sprocket and chain from the independent combination worm-gear shaft. This screw shaft carries a nut moved longitudinally thereon by its rotation, and striking at either end a pivoted switch lever which when moved thereby opens the switch contacts. A slack-cable safety is provided in the form of a pivoted lever operating switch contacts, and having at its upper or long end a rod running parallel to the axis of the drum shaft. On this rod slides a loose-grooved sheave fitting in the hoisting cable. The tension on the cable exerted through the lever keeps the switch continuously closed. This pressure is counteracted by a heavy spring, and should the tension of the cable relax, the lever would be oppositely operated, opening the switch. A centrifugal governor speed safety switch controls the brake circuit.

As will be seen the automatic release, main switch, short stop, and throttle are constructed and operated similarly to those used with the screw machine. The up and down circuit-breakers electromagnetically control double-throw switches, and are so arranged that when both are in their normal down position the armature is short-circuited through a resistance mounted on the controlling board. Only one of these circuit-breakers is operated at a time and suitably connects the armature terminals to give the desired up or down rotation.

The diagram herewith shows the general connections of the duplex interlocking worm-gear drum-winding machine. It will be seen that both the controlling switches, on the car and on the switchboard, are controlled by the throw-over switch, and the various terminals from both controlling switches are connected to the pilot switch terminal board. The pilot switches are exactly similar to those previously described, consisting of two pairs, one on each side of the rotating main contact arm shaft, and are similarly operated. The double switch contacts N'' N'' are operated by the long lever on the main contact arm spindle, when moved to either side, and the single switch contacts O'' P'' by the short arm. The upper short-stop coil is in series with the stop wire from the car-controlling switches, while the lower short-stop coil is connected with the shunt field wires and resistances and the contacts 8′ 8′ on the inner contacts of the main resistance. The up and down circuit-breaker coils are controlled by the pilot switches, but, as will be seen, only one of these can be connected at a time, depending upon the rotation of the long arm and the consequent operation of either one or the other of the double contact pilot switches. The throttle is connected in circuit with the main motor rheostat contact arm and short-circuits, when energized, a portion of the resistance in shunt across the pilot motor armature terminals, consequently slowing its speed. It will be seen that the upper and lower limits and up and down circuit-breakers are in parallel and in circuit with the shunt brake coil, slack cable stop, and short-stop switches.

As is shown in the diagram, the throw-over switch is connected to the controlling switch on the switchboard. Both long arm single contact pilot switches are normally connected with their respective clips when the car is in this position. The note on the diagram

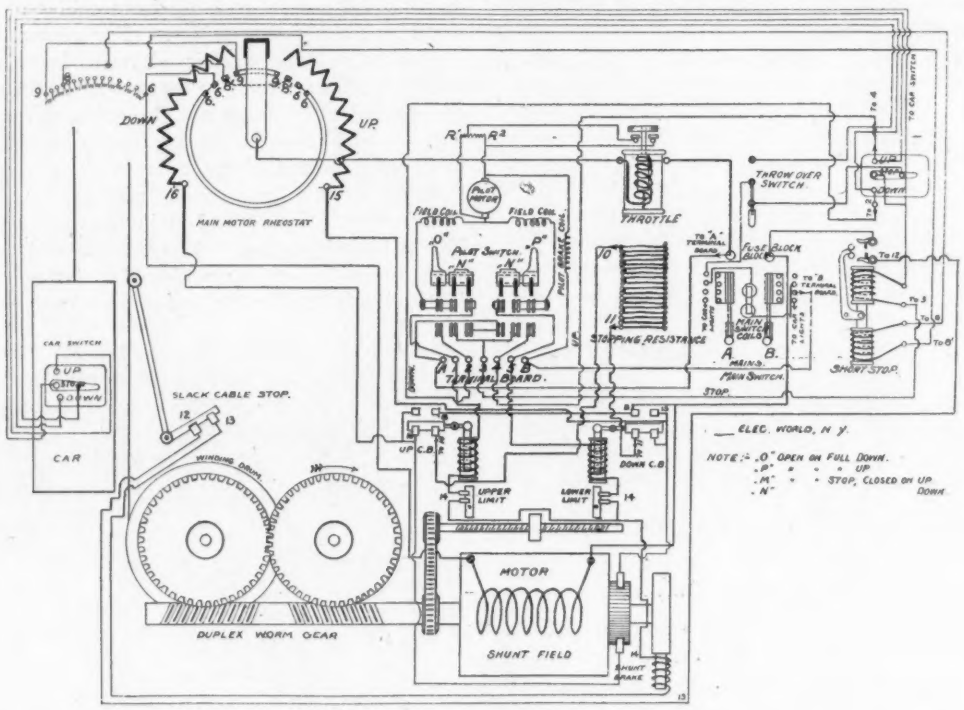
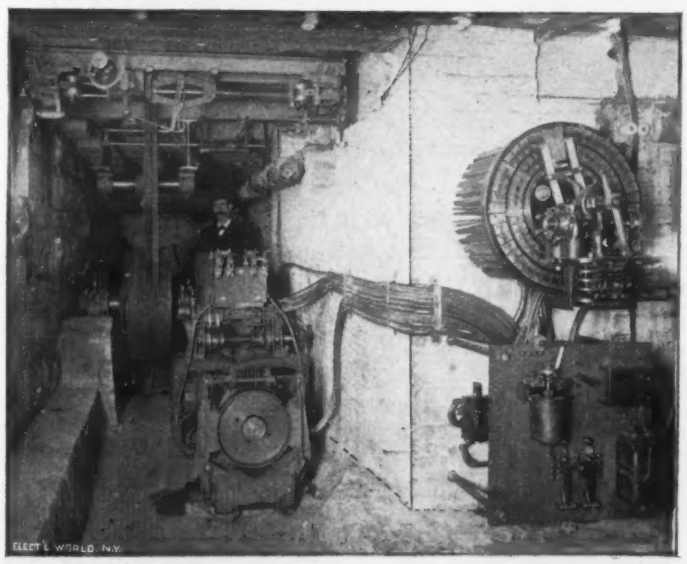


Diagram of Connections—Tandem Worm Gear Electric Elevator.

shows all positions of the pilot switch. Assuming that it is intended to go up, the up contact is made with the car controlling switch, sending current to the single up pilot switch, to one of the differential pilot motor field coils, armature, pilot motor brake, and back to the other side of the line. The pilot motor starts and rotates the main resistance arm over the contacts on the up side, and, at the same time, the long arm on the rotating spindle strikes the double up pilot switch, which is on the opposite side to the single up pilot switch, closing the contacts. This last operation connects the up circuit-breaker coil, and at the same time connects the opposite pilot motor field coil with the stop-controlling wire. It will be seen that in starting and when the motor is inoperative, a resistance is in series with the shunt field. As soon as the main motor contact arm starts to rotate, it tends to cut out this resistance, but first makes connection after leaving its normal position with a contact connected to the lower short-stop coil, thereby energizing this coil and closing the short-stop switch. It is essential to close the short-stop switch in order to continue the circuit through the up circuit breaker and main brake coil, which are then energized. The operation of the circuit breaker opens the short circuit across the armature and suitably connects the latter to the line, while the brake magnet pulls open the brake shoes, allowing the motor to start. If the car is allowed to go to its extreme upper limit the nut on the small screw shaft on top of the motor will be moved longitudinally until it strikes the upper limit switch, which it opens, thereby breaking the circuit including the up circuit breaker and other devices and causing them to return to their normal position, cut-

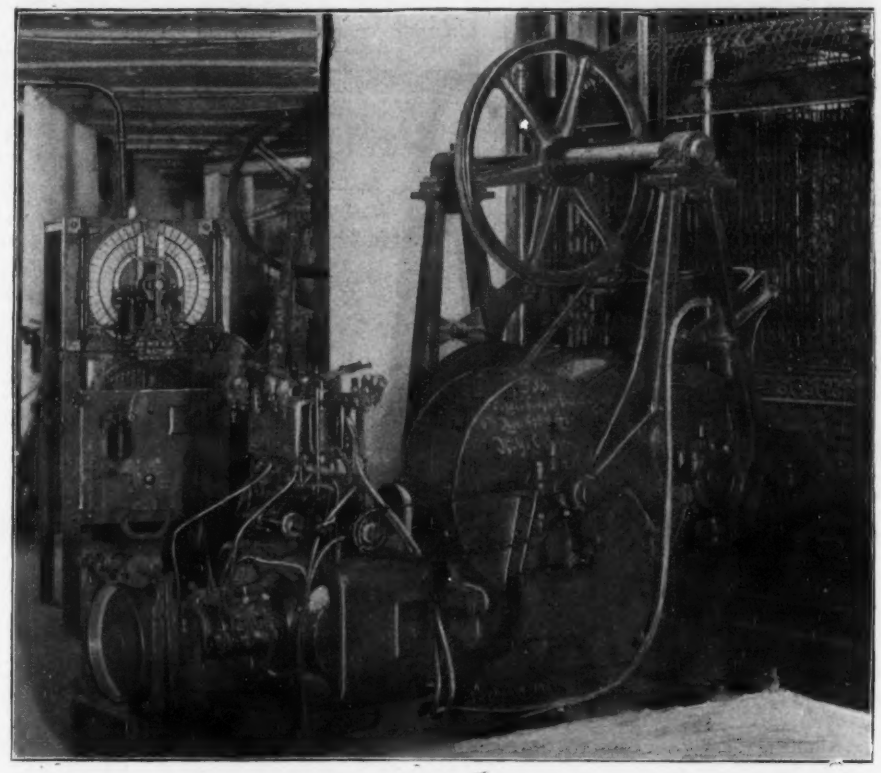
ting off the main current from the motor armature, which is then short-circuited, and applying the brake.

It is to be noticed that the short stop when moved in either position remains so set until operated oppositely. It is only possible to open the short-stop contacts by means of the upper coil in circuit with the stop-controlling wire, and only possible to close them by the lower coil, when the main motor contact arm is at the contact 8′ and at none other. After the contact arm leaves this point it continues to rotate, cutting out all the resistance in series with the shunt field and also gradually decreasing the resistance in series with the armature, which therefore accelerates its speed. The maximum is reached if the pilot motor is allowed to rotate until all the resistance is cut out, at which point the up pilot switch, previously closed, is struck by the short arm and opened, and any further up rotation of the pilot motor is thereby prevented. As in the screw machine, however, the resistance contact arm may be left at any intermediate point by simply making a short contact on the car-control switch instead of maintaining this contact until the stopping of the pilot motor. Should it be desired to stop at any point in the hoistway, the car-control switch lever is permitted to return to its normal central position, which then allows the current to pass through the upper short-stop coil, thereby opening the short-stop switch, and also to the pilot switch, the opposite field coil, pilot-motor armature, pilot-motor brake and back to the line. The pilot motor now rotates in the opposite direction and gradually brings the main resistance arm back to its normal position. At the opening of the short-stop switch the circuit, including the shunt brake and circuit-breakers, has been ruptured, and the up circuit breaker, therefore, is at once de-energized, allowing the switch to return to its normal position, breaking the current supply and again short-circuiting the armature through the stopping resistance. As soon as the stop contact is operated, the main motor is stopped and cannot be started again until all the resistance has been cut into circuit with the armature. The main resistance contact arm must be brought back into contact with the lower short-stop coil contact, thus insuring the starting of the main motor only when the entire resistance is in circuit. It will be noticed that under the arrangement shown herewith a variable speed is possible, both up and down. To decrease in either direction the opposite button is connected.



DRUM-WINDING ELECTRIC ELEVATOR, SHOWING SAFETY DEVICES AT BOTTOM OF CAR.

To go down, the down contact is made, which sends current to the single down pilot switch, pilot motor field coil, armature and pilot motor brake, and back to the line. The pilot motor rotates in an opposite direction, sending the main contact arm around on the down resistance and closing the double down pilot switch, which is on the same side with the single up switch. The closing of this switch throws into connection the down circuit breaker, brake coil, etc., and also at the same time, when the main resistance contact arm comes into connection with the lower short-stop coil contacts the short-stop switch is closed, completing the circuit breaker and brake magnet circuits. The down circuit-breaker magnet is then energized, actuating its switch lever, opening the short circuit across the armature terminals and connecting it suitably across the line. When the contact arm has reached the maximum down position on the main resistance, the single down pilot switch is opened by the short arm on the shaft. As on the up side, the lower short-stop coil is only in connection when the main resistance contact arm is in its first position, and the short-stop switch cannot be closed again if once opened until the arm has returned to this position. It will be noticed that both the main brake and pilot-motor brake are similarly operated, releasing the brake shoes when current flows through the brake-magnet coil. Should the car reach its extreme lower limit, the nut on the rotating limit shaft strikes the lower limit switch, opening the down circuit breaker and brake circuit. Inasmuch as only one of the double pilot switches can be in connection at one time, only one, either the up or down circuit-breaker coil, can be connected.



DUPLEX DRUM WINDING ELECTRIC ELEVATOR AND CONTROL SWITCHBOARD.

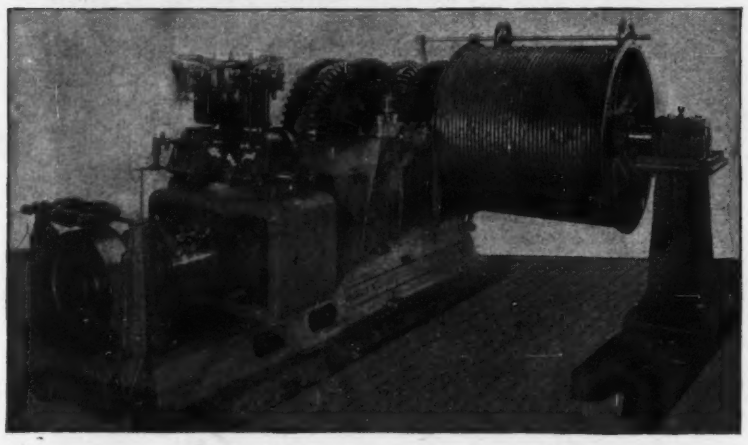
The action of the various other devices, such as the throttle and slack-cable stop, will be readily understood from the previous descriptions. On some of the machines intended for passenger service, a resistance is inserted in the shunt-field circuit when the main resistance is nearly all cut out, thus weakening the field and accelerating the speed of the motor; but for ordinary passenger and freight service the arrangement shown in the diagram is used.

From tests made, a very high efficiency is claimed for this type of machine. The curve herewith shows the efficiency of this machine under various loads at 150 feet per minute, which, although apparently extremely high, is vouched for by the builder. Owing to the particular excellence and efficiency of the gearing, it has been possible, even with over-counterbalancing, to bank a number of machines together and operate them so that the machines going down when well loaded will feed back into the line and supply current to the machines going up. In a very large installation recently put in by the

Sprague Company it has been found possible to obtain the most astonishing results by reason of this action.

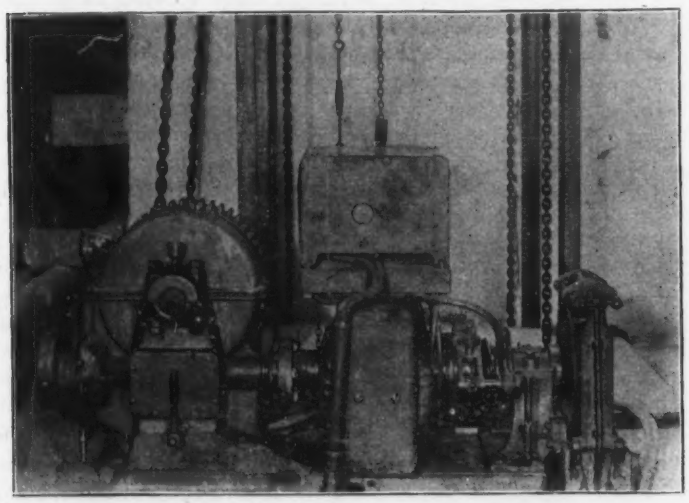
This particular installation includes eighteen passenger and freight elevators of the duplex worm-gear drum-winding type, four sidewalk hoists and one parcel hoist, which are of the single worm-gear drum-winding type. These machines are at work at one of the largest department stores in this country, and are in extremely heavy service during the hours between 10 A. M. and 5 P. M.

The duplex worm-gear machines have a motor of 20-hp capacity, and the sidewalk and parcel hoists have a 10-hp motor. At maxi-



Double Interlocking Worm and Spur Gear, Drum-Winding Electric Elevator.

mum load the large passenger machines take a current of about 100 amperes and can lift from 2500 to 5500 pounds at a variable speed, ranging from 250 to 150 feet per minute. When the load in the car equalizes the counter-balance weight, a current of only 18 amperes is taken, which is comparatively smaller with smaller loads. The main motor or motors are tied together, both in groups and at the switchboard, with the peculiar result that the total current necessary to supply all of these machines from actual wattmeter tests made by the engineers of the users, show that during the rush hours from 10 A. M. to 5 P. M., the total average current taken from the dynamos by the twenty-three elevators is only 180 amperes, or about 9 amperes per motor. This result is certainly due to the back current generated on the down trip of any particular elevator, which tends to supply the other machines on the up trip, only necessitating a current supply from the dynamos amounting to the difference between that generated on the down and that necessary for the up

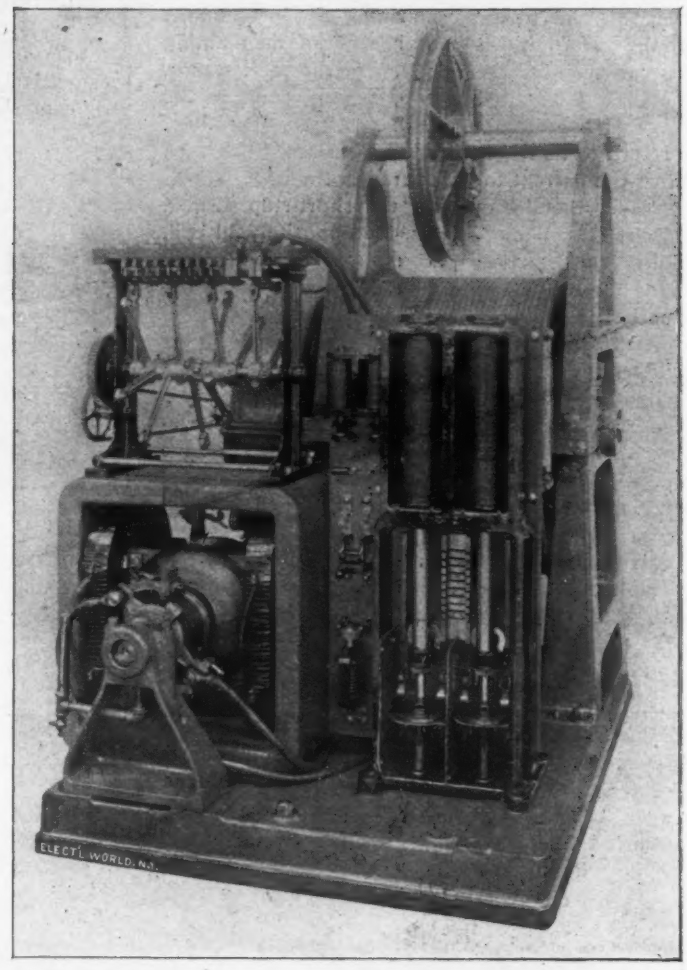


A Sidewalk Drum Electric Elevator.

machines. It will be understood that this result is only possible with considerable loads in the elevator cars going down.

The Sprague Company also builds a number of other drum-winding electric elevators, in which the single worm-gear is used, in some instances of the Hindley type, while in others the ordinary straight screw is employed. The general construction of these machines resembles the machine above described, except that a single instead of a double interlocking gear is used. A solenoid control is sometimes substituted for the pilot motor for the operation of the main motor resistance contacts. A particularly ingenious elevator apparatus which has been recently developed is the automatic house electric elevator. This machine is of the single ordinary worm-gear drum-winding type, generally similar in construction to the other Sprague drum-winding machines, but embodies a number of highly ingenious features in its particular method of control, which is entirely automatic. The motor, hoisting machine and controlling apparatus are all mounted upon a single base.

These machines are operated by an ironclad bipolar motor, shunt wound, of about 5-hp capacity. The hoisting drum is operated by the motor through a single-screw gear running in an oil-filled casing. Between the screw-gear casing and the motor a brake pulley is fitted to the motor shaft. A braking mechanism similar to that used with the previously described drum machine is employed. All controlling appliances are mounted directly on the base of the machine, the various controlling and starting magnets



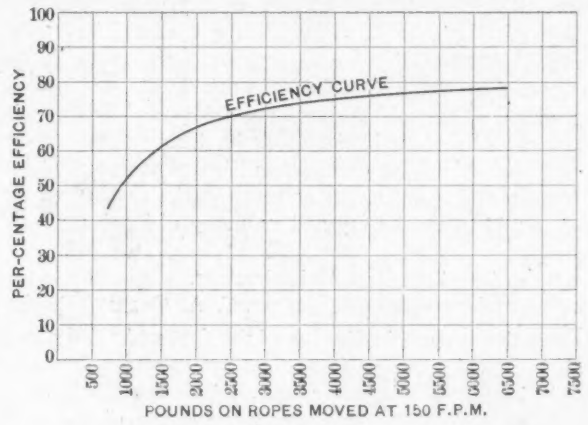
Automatic Control Drum-Winding House Electric Elevator.

and solenoids being all mounted on a vertically placed slate panel, while the automatic stops are placed on top of the motor.

By means of the peculiar apparatus adopted, it is possible to operate this machine from any floor or from the car itself. The operation of any of the floor devices brings the car to that particular floor automatically, without any further manipulation of the controlling apparatus. The apparatus for accomplishing this result consists of up and down resistance and main switch controlling solenoids, an up and down relay and contact devices, and various contact switches, both on the machine and at the different floors, which primarily operate the relay, the latter in turn operating the up or down starting solenoid, suitably connecting the motor and cutting out the starting resistance. The main switch, relay, starting solenoids, main switches and resistance and throttle are mounted on the slate switchboard fastened to the machine base. On top of the motor is fitted a floor limit mechanism, consisting of a shaft rotated by means of a sprocket chain connected to the drum shaft. The shaft is fitted with a number of arms, two for each floor, and also two main limit arms. These arms are fastened at different points around the shaft, and when rotated

operate levers controlling switch contacts which are mounted on a board above the rotating arms. There is an up and down switch for each floor.

At each of the landings, a contact device is placed which is controlled by an electromagnet, so that when operated under normal conditions the contact is held closed by the magnet, and all other floor controlling contacts are locked. Each of the doors of the hatchway is also arranged to operate a switch device which is normally closed when the door is closed. The car is equipped with a lever switch similar to the switch employed for the previously described machines. The operation of any one of the floor pushes suitably energizes the relay previously mentioned, which has an up and down coil, but only one of these coils can be energized, depending upon the position of the car. If, for instance, the car is below the floor to which it is to be brought, the up coil is energized; if above, the down coil is energized. This operation of the relay coils depends upon the position of the floor limit switches operated by the long arms which are either opened or closed, as the car passes up or down by each respective landing. The operation of either the up or down relay coil cuts into circuit respectively the up or down main regulator solenoid, which then, acting upon its core, gradually cuts out the main resistance and suitably connects the main ele-



EFFICIENCY CURVE, DRUM ELECTRIC ELEVATOR.

vator machine motor. Under normal conditions, the motor is kept on short circuit. Should, for instance, a door be open, it would be impossible to operate the relays from any of the contact devices, as the circuits are arranged so that all the door switches and controlling floor contact magnets are in series with all floor controlling contacts. The opening of any door ruptures this circuit. If a door is opened by accident while the car is in operation the magnet is de-energized, releasing the contact and opening the circuit, consequently allowing the relay and main controlling solenoids to return to their normal position. In the same manner, if the car is being operated by means of the car lever switch, it is impossible to operate from any of the floor pushes.

When the car has reached the floor corresponding to the button pushed, the limit switch on top of the motor controlling that particular floor is operated by its respective arm on the rotating shaft and opened. The opening of this switch breaks the circuit of the up or down relay, which consequently at once stops the motor through the opening of the main solenoid circuit and the consequent return of the resistance and main switch devices to their normal position. On the switchboard a throttle is also provided whose function is similar to that of the previously described throttles. In this instance, however, it inserts a resistance in series with either the up or down regulator solenoids. In addition to the automatic stop switches, there is also a main upper and lower limit switch, also operated by arms on the previously mentioned rotating shaft, which directly control the main motor circuit. The slack-cable switch, however, controls the circuit of the up and down solenoids. It is also impossible, while the car is in operation, to operate any of the other buttons aside from the one initially connected, as the operation of the first button locks all others and prevents their being operated until the car has stopped. In addition to the electrical door switch devices controlling the relay circuit, there is also an automatic mechanical locking device at each door, preventing the operation of the door, excepting when the car is at each landing. The operation from the car itself, is, however, not automatic, as it is necessary to bring the lever back to its normal position when it is desired to stop.

National Academy of Sciences, Washington Meeting.

The annual meeting of the National Academy of Sciences at Washington, April 20-22, was fairly well attended, but the number of papers read was unusually small, fourteen in all, of which but a single one was on an electrical subject. This was by Prof. Arthur W. Wright, of Yale, and was entitled "Notes of Recent Experiments Upon the Röntgen Rays."

Professor Wright gave a brief account of his experiments upon the refrangibility of the rays. He began by calling attention to the fact that previous experimenters had attacked this problem with prisms; and as the thicker part of the prism absorbs a portion of the rays, this gave the appearance of a negative index of refraction.

To obviate this, two plates of glass were used. A bar of glass with parallel edges was so arranged beneath them as to give a displacement of light rays amounting to 1.5 millimeters when interposed in the beam at an angle of about 45 degrees.

A platinum wire was interposed in such manner as to indicate whether or not there was any displacement of X-rays, but none could be detected.

Beside the glass was placed a crystal of Iceland spar one centimeter in thickness, but no evidence of displacement and no division of the image was observable; thus indicating the absence of polarization as well as of refraction.

In subsequent experiments the X-rays were passed between the poles of a powerful magnet, and the poles were then reversed, but no change could be noted in the position of the image.

The most interesting point in his experiments is one which he has not yet had time to verify. In passing the rays through a screen or network of platinum wires situated six millimeters in front of the plate, he observed in the centre a faint dark line corresponding to and suggesting the interference lines in the spectrum. Should subsequent investigation confirm this conjecture, it shows that these rays may be diffracted even if they cannot be refracted.

A paper on a new harmonic analyzer by A. A. Michelson and S. W. Stratton described an apparatus represented as being of great practical utility in the mechanical solution in a few minutes of difficult integrations which would require perhaps several weeks to solve mathematically. The apparatus would therefore prove to be a great labor saver in working out many problems of electromotive force, etc.

The other papers read before the Academy were as follows:

"The Influence of Environment Upon the Biological Processes of the Various Members of the Colon-group of Bacilli—An Experimental Study," by Adelaide Ward Peckham, M. D. (presented by J. S. Billings); "On the Energy Involved in Recent Earthquakes," T. C. Mendenhall; "On a Ring Pendulum for Absolute Determinations of Gravity,"T. C. Mendenhall and A. S. Kimball; "Biographical Memoir of G. Brown Goode," S. P. Langley; "Biographical Memoir of Thomas L. Casey,"H. L. Abbot; "Biographical Memoir of Charles E. Brown-Séquard," H. P. Bowditch; "Biographical Memoir of Hubert A. Newton," J. W. Gibbs; "Biographical Memoir of George H. Cook," G. K. Gilbert; "On the Variation of Latitude," S. C. Chandler; "The Position of the Tarsiids and Relationship to the Phylogeny of Man," Theodore Gill; Variation of Latitude and Constant of Aberration from Observations at Columbia University," by J. K. Rees, H. Jacoby and H. S. Davis (presented by S. C. Chandler); "On Recent Borings in Coral Reefs," A. Agassiz.

The following officers were elected: Vice-president, Prof. Asaph Hall, of Washington (vice F. A. Walker, deceased); home secretary, Prof. Ira Remsen, of Baltimore (vice Asaph Hall promoted); treasurer, Prof. Alex. Graham Bell, of Washington.

Additional members elected to the council were: Dr. H. P. Bowditch, Boston; Prof. G. J. Brush, New Haven; Dr. John S. Billings, New York City; Prof. O. C. Marsh, New Haven; Prof. Simon Newcomb and Dr. Arnold Hague, Washington.

The following were elected members of the Academy:

Wm. H. Dall, of Washington; Frank A. Gooch, of Yale University; Dr. Charles S. Minot, of Boston, and Dr. Edward W. Morley, of Cleveland.

The fall meeting will be held at Boston November 16th next.

Fifth Annual Report of the General Electric Company.

Notwithstanding the adverse conditions surrounding business during the past year the General Electric Company has made gratifying progress. The subjoined report shows a reduction of the deficit of previous years by nearly one million dollars. It is to be hoped that the new fiscal year will show much better returns, but the success of the company despite the political excitement and disturbed business conditions of the past twelve months is an index of the condition of the electrical trades both gratifying and encouraging.

Below is the president's report in full, and a summary of the second vice-president's report:

FIFTH ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

SCHENECTADY, N. Y., April 27, 1897.

To the Stockholders of the General Electric Company:

The business of your company has suffered during the past year, in common with that of all manufacturing enterprises, from the disturbed financial and political conditions which have prevailed during a considerable portion of the time. These conditions have curtailed the amount of capital ordinarily available for the establishment and extension of power and lighting plants, and have enforced the practice of great economy on the part of its customers. As a result, the shrinkage in orders received by your company was very marked, especially during the latter half of the year. This shrinkage is not shown by a material falling off in shipments, as given in the profit and loss statement on page 17 of this report, but the amount of work in progress and unfilled orders on hand is considerably less than a year ago.

With a return to normal commercial conditions a corresponding revival in the business of your company may be expected. The volume of business secured by it for the first three months of the current year is slightly in excess of that for the same period in either of the three previous years.

On January 31, 1895 ,the sum of $2,000,000 was set aside, as shown in the annual report of that year, to proyide for shrinkage in assets, exact values of which it was then extremely difficult to fix. During the past year your directors have been able to value these items with substantial accuracy, and the $2,000,000 fund has been found sufficient and has been used to provide for the proper adjustment of all accounts and other assets for which it was created.

BUSINESS OF THE YEAR.

Gross earnings		$12,820,395.87
Less expenses		11,207,388.65
		$1,613,007.22
Deduct.		
Interest on debentures*	$431,250.00	
Less interest and discount, and interest and dividends received on securities owned	370,479.70	
		60,770.30
		$1,552,236.92
Deduct amounts written off.		
Sundry losses and allowances for possible losses	$318,531.13	
Patents	349,919.20	
Inventories and consignments	61,084.36	
	$729,534.69	
Less.		
Profit on securities sold and debentures canceled	136,955.85	
		592,578.84
Reduction of the deficit of previous years		$959,658.08

Additional purchases of your company's debenture bonds have been made during the year to the amount of $750,000, leaving now outstanding $8,000,000. All debentures purchased have been canceled.

The decrease in the amount of interest and dividends received as compared with the previous year, is due largely to the cessation of dividends by the Canadian company, which it is hoped will soon resume dividends on its reduced capital. As a partial offset, there has been an increase in the income derived by your company from dividends on stocks held by it in various local companies.

PATENT LICENSES AND PATENT LITIGATION.

In the last annual report attention was called to an arrangement which had then been concluded with the Westinghouse Electric & Manufacturing Company for an exchange of licenses under patents owned and controlled by the two companies. Your directors are pleased to report that the result of this arrangement has been highly satisfactory.

The result of the work of your company in protecting its patents and enjoining infringers thereof has been especially encouraging, and a considerable number of patents of value has been acquired by it during the year.

The courts have invariably recognized the validity and controlling importance of the Van DePoele patents on the electric railway trolley and switch system, and at the present time substantially all manufacturers of infringing trolleys and switches are under injunction. The company has met with no reverses in its patent litigation during the past year.

Many new suits have been brought, involving important patents, and are now being actively pushed.

SALES, FINANCIAL AND MANUFACTURING DEPARTMENTS.

Attention is called to the reports of the first, second and third vice-presidents, containing much valuable information with respect to their various departments.

The great improvements made by your company during the past year in the design and construction of its apparatus have been very satisfactory. The development in long-distance transmission of electricity and the progress made in electric railway service have been especially noteworthy. Many new enterprises, involving the application of electricity to railways now operated by steam, are under consideration, and the ensuing year promises to be marked by a very rapid growth in that field of work.

Your company has added one large factory of brick and steel construction to its plant in Schenectady during the year, besides completing and occupying another, which was commenced in 1895. Other important improvements at these works are in preparation, designed to add to the facility and economy of handling their output.

By order of the Board of Directors.

C. A. COFFIN, President.

Owing to the absence in Europe of the first and third vice-presidents, their annual statements have not yet appeared, but complete copies will be sent out in due course. The report of the second vice-president deals with the financial condition of the company. From this it appears that during the year there was expended for new patents and patent litigation the sum of $349,919.20, all of which was written off to profit and loss, leaving the patents, franchises, goodwill, etc., of the company standing unchanged at $8,000,000. The book value of the factory plants and lands of the company, including tools, appliances, machinery, etc., stands at present at $3,400,002, the amount of $68,000 having been written off during the fiscal year for depreciation. The present actual value of the company's stocks and bonds is believed to be equal to the aggregate at which they stand in the balance sheet, viz., $8,545,660.68. In addition to this the company owns various miscellaneous securities, of which the present value is problematical, and these are carried at $1 for each lot, making a total of $135.00. The increase in the book value of stocks and bonds since the last annual report amounts to $3,066,463.45. Although some securities have been purchased for cash, most of those recently acquired have been accepted in payment of old indebtedness. Few securities have been sold during the past year, since it has not been favorable to such sales. The profit on those that were sold amounts to $79,816.76. During the year all purchases have been paid for in cash, and none of the money realized from the sale of assets was required for the current business of the company. The total face value of notes and accounts receivable stands in the balance sheet at $5,484,869.75. The inventories of the factories showed an excess over book value of $141,184.98, which is not taken as part of the year's profit, but is retained as a reserve. All other inventories showed a shrinkage from book value of $50,345.85. The company has no notes payable, nor is any paper bearing the company's indorsement or guaranty, under discount. During the year the company purchased and canceled $750,000 of its own debentures at an average cost of 92.38 per cent. The accounts payable at the close of business on January 31, 1897, amounted to only $40,155.32. The mortgage created when the company's building No. 44 Broad Street, New York City, was erected, was paid in full February 26, 1897.

The next annual meeting of the stockholders will be held at Schenectady, May 11, when thirteen directors will be elected.

*On $8,750,000 for ten months and on $8,000,000 for two months.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Machinery. DUBSKY. Lond. *Elec.*, April 16.—The first half of an article on recent developments, with special reference to the Ganz system; it consists almost entirely of illustrated descriptions of the motors and systems used by that company and of insulations made by it. In the present portion he discusses single-phase machinery; in this connection he gives a brief illustrated description of the plant at Rome, in which the synchronous motor coupled with a direct current generator plays an important part; whether a combined light and traction plant can be run satisfactorily together depends on the influence of the varying railway current on the lamps, and on the fact that synchronous motors stop when overloaded; tests have shown decisively that both these difficulties are overcome by using a storage battery in parallel with rotary transformers. Synchronous alternating-current motors are seldom used in practice, except in such special cases as the one cited, their place being generally filled by single-phase induction motors, which are now extensively used; the diagram of the winding of such a motor is given, showing the arrangement for starting, which consists in connecting the winding in a peculiar way with an external resistance and a choking coil; the motors are provided with two pulleys, one of which is loose for starting; in the larger size motors the induced part has a polyphase winding in preference to a three-phase one, which gives them a starting torque nearly equal in every position of the rotating part, the induced current being carried through a water rheostat. There is a very simple method of starting an induction motor if any other motor of the same kind is running near at hand; such a motor is then a phase-shifting transformer and if the three terminals be connected to those of a motor which is running the other motor will start under full load as an ordinary two-phase motor; this arrangement has proved to be very useful; the motors will not come to rest when overloaded if all are thus inter-connected with each other; in one such plant there are six motors, only one of which need be started in the regular way with no load, the others being switched on by ordinary three-pole switches. Another arrangement for starting such motors, which has proved very satisfactory for small motors, is a system devised by Kando, which is illustrated and described; the main current is split into two different phases, and the motor starts nearly like a two-phase motor. Recently, experiments were made with condensers applied to motors; a 6-hp induction motor is started in that way; the condensers are made of tin-foil with dielectrics "of petroleum and vegetable mineral," and will stand several thousand volts; the condensers at Tivoli, Italy, are designed for 10,000 watts and 4000 volts; a condenser plant of 300 kilowatts is about to be erected. Non-synchronous series single-phase motors have been manufactured by that company for some years; they are built like a continuous-current dynamo with a commutator, the alternating current passing through the field, which is laminated; they are switched on through a rheostat; they run nearly sparklessly and require no attention while running; a very large number of these are in use.

Theory of a Self-Excited Alternator. BRILLOUIN. *L'Eclairage Elec.*, April 3.—He endeavors to find whether it is possible to construct a self-exciter without commutator or sliding contact and to study the law of the increase of the alternating current in such a machine; the theory itself is claimed to be of interest as an example of a method of discussion; the same theory applies to microphones and other physical phenomena; after giving the theory, which is brief, he applies it to a high-frequency alternator. The question whether such a system could be used commercially depends on the construction of condensers without absorption or electric hysteresis; as the condenser is not capable of absorbing large powers he suggests the use of a coil instead; a condenser of great capacity is indispensable; the method seems to apply only to large high-speed machines with a frequency in the thousands per second or more.

Property of Non-Synchronous Motors. POTTIER. *L'Ind. Elec.*, April 10, and *L'Eclairage Elec.*, April 3; from the *Comptes Rendus*, 124, p. 538.—A short discussion with a curve showing that there are several possible speeds, stable and unstable; the curve gives the relation between the angular velocity and the accelerating couple; at two of the three speeds the motor can stand an overload without stopping.

Formulas for Transformers. RUSSELL. Lond. *Elec.*, April 9.—A reply to the criticism of Sumpner (see *Digest*). He admits the correctness of the criticism and that his original statements were not quite correct, but are sufficiently accurate for practical purposes; but he does not admit having stated that the triangles formed a figure in one plane; he follows this with a brief mathematical proof of the Ferranti effect which meets the objection of Sumpner.

Rotating Liquid Converter. CARHART. *Amer. Elec.*, April.—A description of a simple device to convert a direct current from any source, such as a storage battery, into alternating currents of one, two or three phases; a simple explanation of the rotary converter with reference to this device is given. The apparatus consists of a large square jar containing zinc sulphate, in which, opposite to each other and close to the sides, are two zinc plates; dipping into the solution are three zinc rods equally spaced, and equidistant from the centre of the jar; the zinc rods are screwed fast to a circular insulating plate, which can be rotated, the rods being connected through rings that have brushes bearing on them, and which convey the alternating currents to the external circuits; the arrangement is such that when the rods are uniformly rotated three alternating currents pass in the external circuit, having a difference of phase of 120 degrees. The same arrangement can be used to produce two-phase currents.

Faults in Direct-Current Motors.—Amer. Elec., April.—Two methods are given for determining insulation faults, one by means of a Wheatstone bridge, and another which involves the use of a storage battery or other independent source of current. Directions are given for the detection and remedy of a number of other faults to which direct-current motors are subject.

Sparking Commutators. HALL. *Amer. Elec.*, April.—An instance is given where a railway motor commutator sparked very badly, which was finally found to be due to the fact that the commutator had been turned off and the brush holders then let down without making the necessary change in their adjustment.

Insulation of Armature Cores. ILLMER. *Amer. Elec.*, April.—Detailed information concerning the insulation of different types of armatures, including instructions to determine the exact size to which insulating strips should be cut, etc.

Designs for a Small Motor. POOLE. *Amer. Elec.*, April.—Instructions accompanied by working drawings for making a 1-6 hp motor with a ring armature.

How to Make a Carbon Brush. COLEMAN. *Amer. Elec.*, April.—A piece of sheet brass is cut in the form of a letter T, and the horizontal portion turned over and soldered about the carbon brush, the vertical part being secured in the copper brush holder.

LIGHTS AND LIGHTING.

Arc Lamps for Street Lighting. HESKETH. Lond. *Elec.*, April 9.—He calls attention to the importance often placed on a slight increase in the efficiency of the machinery, while little or no attention is given to the light efficiency of the arc lamps; he suggests directions for improvement; many arc lamps now regulate within 1.5 per cent. variation in the voltage, leaving little room for improvement in this direction; the factors governing the efficiency are the diameters of the carbons and the length of the arc; according to Schreihage the light varies inversely as the diameters of the carbons; the present writer therefore recommends making the negative carbons as small as possible; this also reduces the loss of heat by conduction and radiation; he thinks the extra cost of recarboning the lamps is insignificant as compared with the amount of light which would be gained; beyond a certain voltage the mean spherical candle-power is almost proportional to the length of the arc, which points to another direction of improvement; this is accomplished in the enclosed arc lamps, from which he expects great developments; some recent tests made by him are referred to, and the curves of the ordinary and the Jandus lamps are given; they show that while at close range the light from the open arc is four times as great, yet at distances beyond 2.5 times the height the enclosed gives more than twice the light of the other and maintains it beyond that distance; he warns persons against obtaining false impressions from the light intensities immediately around the lamp post, where it is not required, while at places 25 to 30 feet off an increase in the amount of light is of very great importance; he thinks the lamp of the future will be an enclosed lamp with carbons of small diameter.

Arc Lamp for Lantern. BRANSON system. Lond. *Elec.*, April 9.—An illustrated description of the mechanism, in which the object is to keep the position of the arc practically constant, as also the inclination of the carbons; this is done by having the carbon holders at the ends of hinged arms

which are made to approach each other by means of a parallel motion device; it is a hand feed lamp.

Standardizing Incandescent Lamps.—Amer. Elec., April.—An account of the work of the Committee of Units and Standards of the A. I. E. E. It is suggested that the completion of the work done by this committee should be placed in the hands of another committee consisting of representatives from the National Electric Light Association, the American Institute of E. E., the Edison Association of Illuminating Companies, the lamp manufacturers, with possibly the addition of an authority on photometry, such as Professor Nichols or Professor Fessenden.

POWER.

Local Distribution in Workshops. Scott. Lond. *Elec. Eng.*, April 16—A continuation of his long serial. After discussing some details, he calls attention to other considerations besides cost, such as convenience and adaptability, which are important in a comparison and which cannot be expressed as a money value; experience has conclusively shown that where electricity is used there has been an increase in production in the factory which has been of greater importance than the saving in the running cost, which at most is only a small factor in the total expenses of a factory; an increased output can be secured by greater convenience and promptness in starting and stopping the machinery; regarding the efficiency at low loads he reprints a (calculated) table of Melotte giving a comparison of the efficiencies at varying loads for both electrical and mechanical transmission; although they at first appear to be equivalent for full loads they become very much in favor of electricity as the load diminishes. He then refers to the test made by Siemens some years ago, giving a table of the results of a six months' test.

Transmission of Power in Factories.—Lond. *Elec. Rev.*, April 16.—A short communicated article describing an installation made recently.

Electric Elevators and Cranes. Ravenshaw. Lond. *Elec.*, April 9.—An abstract of an Institution of Civil Engineers paper; it seems to be general in character, including results of some tests; the abstract contains nothing of importance.

Canadian Niagara Power Plant.—Lond. *Elec.*, April 16.—A reprint of the argument of the company formed in 1892, in their application for an extension of the time commencing the construction, which expires next May.

Ship Crane on Docks.—Elec. Eng., April 21.—A brief illustrated description of the form which has been selected by one of the large German transatlantic steamship companies; it is both lifting and rotary, and can be operated by one man.

Electric Fan Motors.—Amer. Elec., April.—20 illustrations of 1897 models of fan motors.

TRACTION.

Accumulator Traction.—Lond. *Eng'ing*, April 9.—A note calling attention to some recent improvements in English accumulators. The question of accumulator traction is a purely commercial one, the main point being the maintenance of the batteries, as there is absolutely no difficulty from the mechanical point of view and the weight is not excessive. The I. E. S. accumulator is claimed to give an electrical horse-power for nine hours for motive power work, with a weight of less than a quarter of a ton; for the Ribbe cell a horse-power for 12 hours is claimed, with a total weight of 770 pounds; a single charge will run a car 16 hours; the car itself weighs nine tons and the accumulators 2.9 tons.

Accumulator Traction. Sieg. *Elek. Zeit.*, April 1.—A reprint, in full, of the paper which was noticed in the *Digest*, April 17.

Calculation of the Distribution Wires for Railways. Pellissier. *L'Eclairage Elec.*, April 3.—He discusses the subject in general, showing that they ought to be calculated to satisfy the Kelvin law and not involve more than a certain fall in voltage, two conditions which cannot both be satisfied; he suggests that a sufficiently close approximation can be obtained by assuming that the current for a car remains constant during the whole trip and not to consider the starting or the stoppages; this he discusses at some length and gives formulas; the results are not of such a nature that they can be given in abstract here.

Electric Railways and Municipalities.—Lond. *Elec. Rev.*, April 16.—A communicated article involving suggestions as to the ownership. He thinks the most satisfactory arrangement is for the municipalities to provide the electrical energy from a municipal station and also to lay down and maintain the permanent way, including the feeders; the railway company would then on payment of agreed sums operate the lines under a lease, and construct and maintain the overhead structure.

Recent Developments in Electric Traction Appliances. Baylor. Lond. *Elec. Eng.*, April 16.—A continuation of his long Institution paper (see *Digest*, last week). (It appears to be based largely on American practice, most of which will therefore be found to be familiar to American readers.) He discusses switchboards, overhead lines, ground returns, three-wire system, motors and controllers.

A reprint is begun in the Lond. *Elec. Rev.*, April 16; an abstract is given in the Lond. *Elec.*, April 16.

Railway Statistics for Europe.—Elek. Zeit., April 1.—A reprint of some of the summaries from the article noticed in the *Digest*, April 3. These tables, reduced to miles, are reprinted in the Lond. *Elec. Rev.*, April 16. One of the tables (in which the lengths are not reduced to miles) is also reprinted in the *Elec. Eng.*, N. Y., April 21.

Budapest.—Lond. *Elec. Eng.*, April 16.—An illustrated description of the railway system.

An Electric Railway Expedient.—Amer. Elec., April.—An armature of a street railway generator having been destroyed by lightning, an extra armature was fitted, which was two inches less in diameter, and six inches shorter than the one it replaced; besides, its brasses did not fit the pillow blocks on the injured dynamo. The various expedients are described whereby the machine thus repaired was enabled to take care of part of the load while the original armature was being repaired.

Heilmann Locomotive.—Elec. Rev., April 21.—A reprint of the article from the Lond. *Elec.*, noticed in the *Digest*, April 17, with an illustration of the locomotive.

Repair of Electric Railway Motors.—Amer. Elec., April.—Instructions are given for forming the coils used in the several types of symmetrically wound armatures; the forms described are such as may be very simply made, consisting merely of a board having holes in which pegs may be variously located, depending upon the type of coil.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

A New Form of Lightning Arrester. Goerges. *Elek. Zeit.*, April 8.—A reprint of a paper read last November, with an illustrated description of a new form of lightning arrester and of experiments made with it, including photographs of the discharge; the arrester consists merely of two bent wires which are close together at their lower ends and then gradually separate, one of them being connected to line and the other to ground; the arc which forms at the lower ends is forced upward by both the heat of the arc and the electrodynamic action of the currents in the wires on that in the arc; (this arrester was described some time ago in the *Digest*). Experiments made in the development of this arrester are described: these show that it is essential to have the current enter at the bottom of the wires or else the arc may be driven downwards or be maintained; also that it is important to use wires and not flat pieces as in the Thomson form, in which latter the current passes through the whole metallic piece, and there is, therefore, no directive action on the arc; the arrester works better the higher the voltage, and the lowest limit has been taken as 2000 volts; 100 short circuits at 10,000 volts were made and no important burning action was shown on the wires, although they became roughened; with low voltages the wires are likely to burn and this prevents the arc from moving upwards; photographs of some of the discharges are shown; it has been in use in a number of installations during the past summer and has shown itself to be quite satisfactory; it is not necessary to cover it if it is used in the open air. In the discussion Benischke stated that he used a similar device in a 15,000-volt installation with very good success, but had a very unfavorable experience in that he found that the porcelain plates used in the insulation were in time completely destroyed; trouble was also experienced from insects.

Cost of Electricity at Brighton. Wright. Lond. *Elec. Rev.*, April 16.—A table which shows how favorably electricity compares with gas as the consumption increases (the results being presumably based on the Wright system of charging); from this it appears that the annual cost is less for gas when the average number of hours is one per day; the turning point is between two and three hours a day and is very greatly in favor of electricity at 24 hours a day. He also gives the time in which the cost of fitting out the electric light will be repaid by the saving; this varies from 2 1-2 years for three hours a day to five months for 24 hours a day.

Country House Lighting. Rosling. Lond. *Elec. Rev.*, April 16.—Some additional data supplementary to Graham's article (see *Digest*, April 17), showing that 15 lamps of 16 cp from one brake hp is not out of the way for high efficiency lamps; from the figures which he gives the whole cost of running for a small plant is on a par with gas, and on anything larger than the smallest considerably less.

Ft. William.—Lond. *Elec.*, April 16.—A brief description of this plant; water power with a 120 ft. head is used; there are two turbines of 60 hp each and the dynamos have a double winding on the armatures, one giving 500 volts used for the transmission and for the charging accumulators at the distant station, and the other of 120 volts used for local lighting and exciting the fields; the energy is charged into accumulators which are then discharged on the three-wire system with 150 volts to the side; the town incandescent lights can be switched on to either side of the battery to balance the charge.

Automatic Cut-out.—Lond. *Elec. Rev.*, April 16.—An illustrated description of one made in England; it is both a maximum and a minimum cut-out; when used with a motor it prevents the attendant from starting the motor with a full current on, as it also releases the starting switch.

Storage Battery Engineering Practice. Appleton. *Elec. Eng.*, April 21.—A continuation of his serial. He gives a curve showing the capacity of a battery at various rates of discharge; this is nearly a straight line, the capacity at a one-hour rate being about half that at a 10-hour rate; he shows that this does not mean a loss of efficiency of 50 per cent., but merely that the rest of the charge cannot be gotten out on account of polarization, and that it only requires a corresponding amount of a charge to fill the battery again; he shows the importance of taking both voltmeter and hydrom-

eter readings, as the former are not always an indication that the battery is charged; it should never be left discharged; if a battery receives the attention and care given to machinery its cost of maintenance will be less than that of machinery; it differs from machinery in that overworking it will not show immediate signs of distress, although the damage is done and will eventually show itself; to bring a sick cell back to the normal charge it should be cut out on one or two of the discharges but inserted during the charges. He describes and recommends an accurate test for ascertaining the condition of a cell by means of a plate of cadmium placed in the solution, the voltage between it and each of the plates being then measured, thus locating any trouble in either the positive or the negative plates; a list of readings of a normal cell under various conditions is given; during the charge the cadmium reads negative to the negative plate until the cell is full, when the reading should be zero, but the charge should be continued until the cadmium is 0.20 volt positive to the negative plate while the charge is going on.

ELECTRO-PHYSICS AND MAGNETISM.

Adaptation of Röntgen Rays to Measurement of Contact E. M. F. PERRIN. Lond. *Elec.*, April 9.—A translation of the article which was noticed in the *Digest* last week.

X-Ray Action on Gases.—Lond. *Elec.*, April 9.—A notice of a summary of some French Physical Society papers.

Action of Cathode Rays on Diamonds. MOISSAN. *Comptes Rendus*, No. 13; noticed briefly in the Lond. *Elec.*, April 9.—He found that the black coating produced on diamonds exposed to cathode rays is a very stable form of graphite; this is interesting, as the transformation of diamonds into graphite requires a temperature of at least 2000 degrees C., and if this temperature is not produced by the impact of the cathode rays, the latter must possess some chemical property not hitherto investigated. (The question of the temperature was discussed by Dr. Heen, in *Digest*, April 24, under "Röntgen Rays").

Mutual Action of Electrodes and Cathode Rays. DESLANDRES. *Comptes Rendus*, No. 13; noticed briefly in the Lond. *Elec.*, April 9.—He investigated the repulsion between two beams of cathode rays from two electrodes close together, and found that attraction could be produced by making one cathode into an anode and leaving it disconnected; on surrounding one pair by a mica cylinder all action ceases, an observation which requires an explanation.

Electrical Vibrations. RAYLEIGH. Lond. *Elec. Eng.*, April 16.—An abstract of the last of his recent course of lectures. Abstracts of the fourth and fifth lectures are given in *El'ty*, N. Y., April 21.

Capacity of a System of Three Conductors. A. P. *L'Ind. Elec.*, April 10.—A short article showing how the capacities of a system of three conductors may be graphically represented by a triangle with perpendiculars from the points to the sides.

Decimal Division of the Angle and of Time. HOSPITALIER. *L'Ind. Elec.*, April 10.—A report accompanied by an unfavorable criticism, concerning the attempt that is being made by a French commission in this direction.

X-Ray Picture of a Bone Graft. DUNLAP. *Elec. Eng.*, April 21, and *West. Elec.*, April 24.—A reproduction of a photograph of a bone of a man's leg, to which has been grafted a piece, five inches long, from the femur of a sheep; it shows that the sheep's bone has taken life and that the process of repair is going on.

Law of Transparency of Bodies to X-Rays. BENOIST. *El'ty*, April 21.—A reprint of the abstract noticed in the *Digest* April 10.

ELECTRO-CHEMISTRY AND BATTERIES.

Traction Accumulators for Rapid Charging. EPSTEIN. Lond. *Elec. Rev.*, April 16.—He abstracts a recent French paper by Blanchon (see *Digest*, April 17) and then criticises some of the recommendations made therein. He considers that Blanchon represents only one side of the question; Blanchon claims that there is less wear and tear if a large battery is used on the car in place of smaller ones that have to be exchanged; Epstein thinks that, with proper appliances, the exchange of the batteries could be effected with a minimum detriment to the plates; it is undoubtedly an advantage to charge at a constant potential, that is, very rapidly at first, but on the other hand this necessitates a much larger generating plant, making the first outlay greater, as also the cost for interest, etc.; the suppression of vigorous gassing and prevention of useless work can also be accomplished when the difference between the maximum and minimum charging current are not as great as they would be at absolutely constant potential; the alleged advantage of reduced voltage of the dynamo is more than compensated by the increased amperage; beside the above there are other important considerations which are ignored in the paper; a heavier battery and car involve an increase in a number of the expenses; experience alone will show whether rapid charges and heavy batteries fixed permanently on the car, or moderate charges and lighter batteries which are exchangeable give the best commercial results; the most satisfactory solution will probably be found in a compromise.

Industrial Applications of Ozone. ANDREOLI. *L'Elec.*, April 10.—The conclusion of his long serial (see *Digest*, April 17). He calls attention to the fact that manufacturers do not seem willing to aid in developing the application of ozone by giving it a fair trial; many demand of ozone what is impossible or nearly so, and unless they have reason to think that the results will be marvelous they take little interest in what is or might be possible. Some of the liquids and compounds in the market which are claimed to contain ozone are mentioned, and attention is called to the fact that ozone is not soluble in water and it is intimated that many if not most of them contain no ozone at all. To show the difference between a good and a moderately good ozonizer he states that in the apparatus which he formerly used, a square foot of plate gave 18 grams of ozone per hp-hour, while those which he used now with the same surface, but in which the air is in contact with the plates but a short time, gave from 34 to 48 grams of ozone; the chief problem is to produce ozone economically, and he believes that his apparatus accomplishes this; on a basis of 30 grams of ozone per hp-hour, which cost two cents, he calculates that 0.3 kg will cost 20 cents, 3 kg $2, and 30 kg, requiring 1000-hp hours, $20.

Industrial Production and Application of Ozone. LEFEVRE. *L'Ind. Elec.*, April 10.—An abstract of the recent article by Andreoli which was noticed in the *Digest*, March 6.

Aluminum. BECKER. *L'Eclairage Elec.*, April 3.—A brief abstract from *L'Ind. Electrochimique.*—He shows the great importance of having the pure metal and points out the great difficulties in making it so; he abandons the idea of obtaining it pure directly by means of the electric furnace, and advocates producing an inferior but cheap metal by using bauxite, and then purifying the product chemically.

Extraction of Metals from Ores. HOEPFNER process. *L'Elec.*, April 10.—A brief description of this process, which is said to be used on a large scale in the United States; it consists in treating the pulverized ores with a warm solution of perchloride of copper, including also chloride of sodium and of calcium.

Thermo-Electric Batteries. REED. *Amer. Elec.*, April.—A summary of the principles of the thermo-electric battery; the various types are classified and some of the more important ones considered in detail. Thermo-electric batteries are divided into two general classes; those not containing electrolytes, or those in which no chemical action takes place, and those containing an electrolyte, or those in which the passage of an electric current causes electrolysis or chemical action. The difference between these types is so great that those belonging to the second class have frequently been mistaken for galvanic batteries; this latter type is said to have comparatively a very high possible efficiency, both on account of high thermo-electric power, and of the fact that the chemical or electrolytic reactions may be used to advantage to oxidize fuel within the thermo-electric circuit, its energy being added to the circuit. The Archereau and Jacques cell belongs to the second class; while great claims have been made for the efficiency of this cell, its commercial utility will depend more upon the labor and cost of renewing the electrolyte, carbon and iron pots, and of the convenience and adaptability than upon its efficiency. Of the Case cell it is stated that the energy concerned in the chemical reactions takes no part whatever in the production of the electric energy; any chemical reaction which evolves energy must, on reversing, absorb the same amount of energy, and any chemical reaction which absorbs energy must, on reversing, evolve the same amount of energy; the supposition that the chemical action in this cell contributes in any way to the production of the electrical energy involves the admission that an isolated body of matter is capable of absorbing external heat at a low temperature, and evolving it without loss at a higher temperature, which is impossible, since it implies the possibility of perpetual motion. The conclusion arrived at is that a study of the thermo-electric properties of bodies heretofore examined gives little or no reason to hope that this method will ever be preferred for the transformation of energy on a large scale, except through the discovery of new chemical elements having properties radically different from the properties of any known substance; while there is undoubted a possibility of such a discovery, the probability is not encouraging.

Electricity in Chemical and Metallurgical Industries. KERSHAW. *El'ty*, April 21.—A reprint of the last article of his series, which was noticed in the *Digest*, April 17.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Instruments. RAPS. *Elek. Zeit.*, April 1.—A reprint, with numerous illustrations and diagrams, of a paper read in November, describing a universal registering instrument, a new universal galvanometer, and an instrument for measuring insulation, all three made by Siemens & Halske. The chief feature in the registering instrument is that there is no friction of the pointer on the paper; the force required for registering is supplied externally by a clockwork which depresses the pointer every two seconds against a strip of thin paper, behind which is an ink ribbon which is kept moving slowly; the curve formed is visible through the thin paper, and although made up of points is practically a continuous line; the measuring instrument is based on the same principle as the Weston instruments. The second instrument, which is a universal galvanometer, is an improved form of that well-known instrument which is used so largely in Germany; one of the improvements is that the result may be read directly without the use of a table; no particular care is required in mounting the instrument; descriptions are given for using it and the instrument for insulation measurement, the description being accompanied by diagrams and formulas; it is called a universal instrument because it can be used for measuring voltage, current and resistances.

Bois Magnetic Balance. Ebeling and Schmidt. *Elek. Zeit.*, April 8.—A contribution from the *Reichsanstalt*, reprinted from the *Zeit. f. Instrumentenkunde*, 16, p. 353, in which is given the results of a very careful investigation of this apparatus. It is accompanied by an illustrated description accompanied by curves of the results (the apparatus was described in both of these journals nearly five years ago); the relative readings were investigated, the effect of the vertical compound of the earth's magnetism being shown; this is not small, but can be compensated by means of external magnets which utilize this field; the effect of the leakage and the cross-section of the rods is also investigated and the method for calibrating the balance is described; it consists in measuring a rod of iron, then turning it off into ellipsoids and testing it again magnetometrically.

Electrodynamometer of Helmholtz. Kahle. *L'Eclairage Elec.*, April 3.—A long translation from the *Wied. Ann.*, 59, p. 532, giving an illustrated description of the instrument, which belongs to the class of electrodynamometer balances and differs from the others of its class in details of construction, and in the form of the standard coil which is used for determining the constant in absolute measure.

Standard Cadmium Cell. Jaeger and Wachsmuth. *L'Eclairage Elec.*, April 3.—Translation in part from the *Wied. Ann.*, 59. p. 575, accompanied by an illustrated description; numerous tests were made with it; it is presumably the same article as that referred to in these columns before.

Measurement of Resistances. Armagnat. *L'Eclairage Elec.*, April 3.—A continuation of his long serial on instruments; he discusses the measurement of resistances.

Candle-Power of a Search Light.—Amer. Elec., April.—With a photometer measure the candle-power of the cylindrical beam some hundreds of feet distant from the reflector, and midway between the center and periphery; also measure the diameter of the beam at the same point; multiply the candle-power thus found by the square of the diameter of the beam, and divide by the square of the diameter of a circle having the same area as that of the effective carbon crater. An example is given of a beam 24 inches in diameter and with an effective crater five-tenths inch in diameter, the photometric measurement of the beam being 2000 cp; multiplying these quantities as indicated gives a candle-power of 4,608,000; an open arc light would have to be of this candle-power to give an illumination at any point equal to the illumination of this beam at that point.

TELEGRAPHY, TELEPHONY AND SIGNALS.

A Unit for Measuring Cable Speeds. Raymond-Barker. Lond. *Elec. Rev.*, April 16.—He shows that there is no definite standard in terms of which the commercial carrying capacity of a cable can be satisfactorily expressed, as neither the number of signals, letters nor words expresses it correctly, owing to the fact that the spaces are not included, the lengths of which vary as 1 to 3 to 7 between parts of letters, between letters and between words; a proper unit should include spaces as well as letters. He therefore proposes as an "element" the letter *e* and recommends measuring letters, words and spaces in terms of this element; from an average communication of 1000 words in ordinary language he finds that the number of elements per letter is 7.157; on this he bases some formulas for use in calculation of speeds, emphasizing the necessity of basing all speed calculations on this fundamental unit. In dealing with secret cipher traffic it is best to use, in place of the above constant, the average number of elements per letter in the international code alphabet.

Nickel Stress Telephone. Garrett. Lond. *Elec.*, *Elec. Eng.* and *Elec. Rev.*, April 16.—Abstract of a Physical Society paper. He experimented with telephones having nickel magnets and magnetized nickel rods being wound with wire, and having a wooden diaphragm rigidly attached to one end; it does not work well as a receiver, and it is thought that the alternating currents are due to magnetic variations arising from changes of stress. In the discussion Dr. S. P. Thompson said that he had worked with a similar apparatus some years ago, using it as a receiver as well as a transmitter, and it did not work well; Appleyard said that the arrangement was interesting historically, as it was very similar to the instrument of Reis; Garrett in his reply stated that these telephones gave a better articulation, but the sounds were considerably feebler, and there seems to be a certain field strength which is best for each instrument.

Vertical Crossings of Telephone Line Wires. Pierard. *L'Elec.*, April 10.—A short illustrated article in which he shows a simple method of crossing the line wires of a telephone circuit in a vertical plane in order to avoid induction from neighboring circuits; the insulators are supported on the pole directly, and are placed in such a way that the planes of the two wires are slightly separated so that there is no danger of the wires coming into contact with each other where they cross; it is also possible to see, without climbing the poles, that there is no contact. (It is doubtful whether the method is practicable, as the pull on the insulators is not taken up at their support so as to prevent them from being twisted.

Alternating Currents in Concentric Conductors. Price. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, April 16.—An abstract of a Physical Society paper in which he gives a mathematical investigation of a proposed new form of submarine cable, the case of which consists of two concentric conductors interrupted alternately at different points throughout the length; his theory indicates that under no circumstances can the speed of a cable of the proposed form be greater than the speed of a cable of the ordinary type; on an artificial cable connected up in this way he found that the definition was considerably better.)

New Telephone Station at Christiania. West. *Elek. Zeit.*, April 1.—A very, long profusely illustrated description of this new station; the system is based on the 1895 model switchboard of the Western Electric Company with certain departures and improvements; each section is arranged for 450 subscribers, so that every attendant can take charge of 150 subscribers, which the author claims is higher than anywhere else, to his knowledge; the illustrations seem quite complete. The largest number of connections which one attendant has had to make was 910 during a period of four hours, that is, an average of 227.5 per hour.

Morse Code. Humstone. *Elec. Rev.*, April 21.—A short communication, including a copy of the code at present in use by the Western Union Telegraph Company; it involves only a few changes in some of the punctuation marks; the chief and only objection to the Morse code has been the liability to error where the spaced letters occur in juxtaposition, but his experience has been that only very few errors are due to this cause.

Telephone Calling Apparatus. Miller. *Amer. Elec.*, April.—The various forms of telephone calling apparatus are described and illustrated in detail, and designs of several types discussed.

Reconstruction of the Telephone Lines in Westchester County, N. Y.—Elec Eng., April 21.—A map of the new circuits and a list of the rates charged.

Intercommunicating Telephone System.—Amer Elec., April.—A diagram is given of line connections, and also of the connections of battery and magneto telephones.

MISCELLANEOUS.

Physiological and Therapeutic Action of High-Frequency Currents. d'Arsonval. *L'Ind. Elec.*, April 10.—An abstract of an International Society paper. He showed the methods of tracing the curves of variation of the current in the excitation of the nerves and showed the powerful induction produced by high-frequency currents, mentioning some experiments which are now well known; among the principal results obtained are the increase in the oxidation of the organs; a subject yielding 17 to 21 liters of carbonic acid gas per hour yields 37 after having been subjected to high-frequency currents; they also increase the production of heat in the subject; there is also an action on the nervous system, but not on the nerves of pain; these currents penetrate deeply into the interior of the body and are not localized on the surface; that they are not felt is due to the fact that nerves are susceptible only to waves of certain lengths. He also experimented on microbes and bacteria and obtained results which are certain and show that the poisons are destroyed and transformed into vaccines; he also treated patients having diseases due to microbes, but the results are not conclusive; in conclusion he describes a simple apparatus for generating these currents with a Ruhmkorff coil and a mathematically operated break.

Burglarizing Safes. Noe. *Elec. Eng.*, April 21.—A discussion of the feasibility of burning holes through safes by means of the arc; he takes the same view as Prof. Thomson and others, namely, that while it is possible, it requires so much apparatus and power that it would be practically impossible to use the method for the purpose of burglary.

Congressional Bills on Electrical Matters.—West. Elec., April 24.—A brief summary of the bills recently introduced in Congress on legislation of an electrical nature.

Electrical Catechism.—Amer. Elec., April.—The current installment treats of polyphase alternating currents.

Book Review.

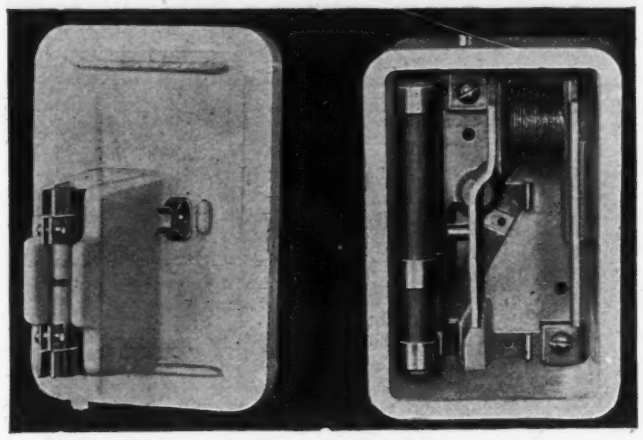
Electricity and Magnetism. By Eric Gerard. Translated from the fourth French edition by R. C. Duncan. New York: The W. J. Johnston Company, 1897; 392 pages. Price $2.50.

Professor Gerard's original work appealed to a large class who were not satisfied with elementary text books, and who, on the other hand, could not master the more abstruse works, such as that of Professor Mascart. The mathematics are as simple as possible, and the language is concise and perspicuous. The fact that the work has reached a fourth edition in the original French and has been translated into German is sufficient evidence that there is a large class of readers for the book and justifies the translation into the English language. There are several new chapters added, one by Mr. Steinmetz on "Hysteresis," one by Mr. Kennelly on "Impedance," and one by Dr. Cary T. Hutchinson on "Units." The present translation is confined to one volume, but it contains all the distinctive features of the original work, and that which made it valuable above other works on electricity. There was a large amount of descriptive matter in the original that referred almost exclusively to European practice and is not of any great value here, besides which it may be found in other books. This matter has been omitted from the present edition, but the omission does not affect its value to American readers. The volume is carefully indexed, which is a merit in any book, and the mechanical make up is good, corresponding with the recent publications of Mr. Steinmetz and Dr. Bell from the same publishers.

Magnetic Blow-out Lightning Arrester.

In order that lightning arresters may be effective in conducting away high potential discharges generated in overhead lines by atmospheric disturbance, they must have less resistance across the spark gaps than the apparatus to be protected.

In the new arrester for 500-volt continuous-current work, known as type



CLOSED. LIGHTNING ARRESTER. OPEN.

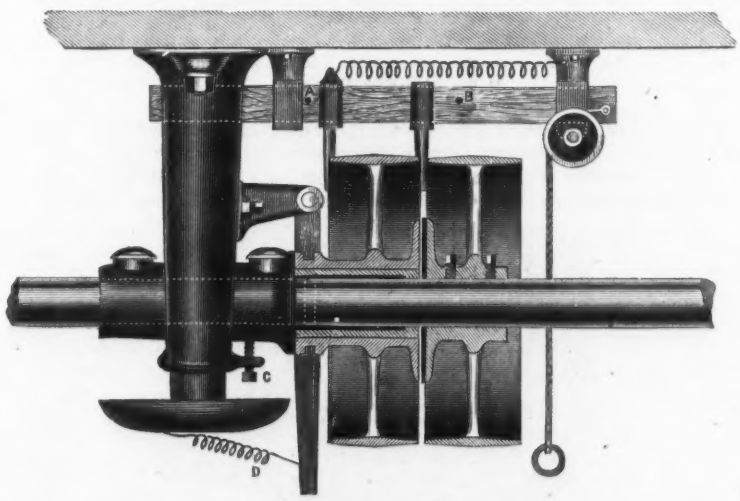
M-D, recently designed by the General Electric Company, the spark gap which separates the overhead line connection from the ground connection is only one-thirty-second of an inch, and 2000 volts only are required for the electric current to bridge this gap. After the passage of the high-voltage current, if there were no means of rupturing the arc, a short circuit would be maintained, and the lightning arrester would be completely destroyed. In this arrester, the gap is placed in a strong magnetic field, which tends to force the arc from the field and ruptures the current. It is the same principle employed for rupturing arcs in circuit breakers and car controllers.

In order to limit the current, a low non-inductive resistance is placed in circuit. The spark gaps are mounted on the cover and may be easily removed from the circuit for inspection and adjustment. In the station type, all the metal parts are contained within a substantial porcelain box. For line use, the arrester is placed in a case iron or wooden box.

A New Kind of Loose Pulley.

Many users of belted machinery are annoyed by the wear of loose pulleys and by the generally slipshod mechanical arrangements of their installation. For some reason the loose pulleys in the ordinary shop receive very little attention, are rarely properly lubricated because of the difficulty of getting at them, and in the course of time become a nuisance. When an idle belt is upon the loose pulley, it stands still under the full tension of the belt, wearing the shaft and the pulley bushing, tending to heat and cause trouble in many ways.

These considerations have led to the design of the arrangement here illustrated, which is patented and manufactured by the George V. Cresson

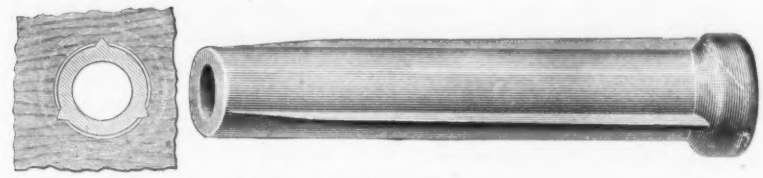


IMPROVED LOOSE PULLEY.

Company, Philadelphia, Pa. It is intended for use in any place where a loose pulley can be put in, and is especially adapted for high-speed machinery, being to a considerable extent a substitute for the friction-clutch pulley. As will be seen from the illustration, the loose pulley is supported on a sleeve which forms a part of the hanger. The hub of the loose pulley is flanged, the flange abutting against a similar enlargement of the hub of the running pulley, and between the two flanges is a rubber disc. By pressing a lever which moves the loose pulley laterally, it can be brought into frictional contact with the tight pulley and thus slowly take up its rotary motion. The automatic shifting device begins to move the belt from the loose pulley to the tight pulley as soon as the former commences to rotate. A cord or lever is arranged to shift the belt back to the loose pulley at any time. When the belt is on the loose pulley and the driven machinery is standing still, there is no motion of any of the parts with relation to each other, and the losses from friction, which have been such a fruitful cause of waste and trouble in many places, are entirely eliminated.

A New High-Insulation Porcelain Bushing.

Many electricians have experienced the annoyance of having the ordinary form of porcelain bushing drop out of place from the lack of proper wedging. To overcome this difficulty a new style of bushing has recently been patented by Mr. Miner Robinson, 302 Equitable Building, Boston, Mass., and is to be used in leading wires through beams and other materials. The



PORCELAIN BUSHING.

improved tube is provided with three narrow ridges running longitudinally, which serve as a wedge to hold it firmly in position. The device may be driven in completely or only part way, the latter being very advantageous when the wires turn corners. The prominent features claimed are a high insulation resistance, low cost of manufacture and security in fastening.

A New Telephone Desk Set.

The accompanying illustration represents a new form of telephone desk set recently put on the market by Taber & Mayer, 185 Franklin Street, Boston. The transmitter is of the granular-carbon type, having two diaphragms, on which the company holds letters patent. The watch case receiver is specially designed for the set and the stand is of brass heavily nickeled. Projecting slightly above the base is a battery call-button, while below is an induction coil, together with a very compact buzzer for signalling.

A recent important addition is an improved gravity hook, which occupies very little space. The set is made with great care and with its high finish presents a very pleasing appearance.

Portable Voltmeters.

The Keystone Electrical Instrument Company, 901 Montgomery Avenue, Philadelphia, Pa., announces that it is now prepared to offer a complete line of portable voltmeters for combined use on the direct and alternating current.

This line of voltmeters is the result of a large number of experiments

DESK TELEPHONE.

PORTABLE VOLTMETER.

covering several years, followed by time tests in actual practice, therefore the company feels that it is warranted in claiming that its portable voltmeters meet the requirements of practical use under all conditions.

In the construction of these voltmeters nothing is incorporated which is subject to change or deterioration and, having been calibrated from absolute standards of voltage, may be relied upon to maintain their accuracy.

The system is such that there is no magnetic lag nor any error due to self-induction, therefore they are independent of frequency variations on the alternating current.

They are mounted in highly polished mahogany cases with key, lock and leather carrying handle. With each instrument is included a pair of flexible leads, for which a special compartment is provided.

Two features are embodied which busy users will appreciate; one is that the instruments are dead-beat without the use of a mechanical brake, and the second is that each instrument is provided with a switch for reversing the direction of the current-flow through the voltmeter when used on direct-current circuits. This latter enables the user to obtain mean readings easily and promptly, and further, by turning the switch to the dead-point, to throw the instrument out of circuit without disconnecting the leads.

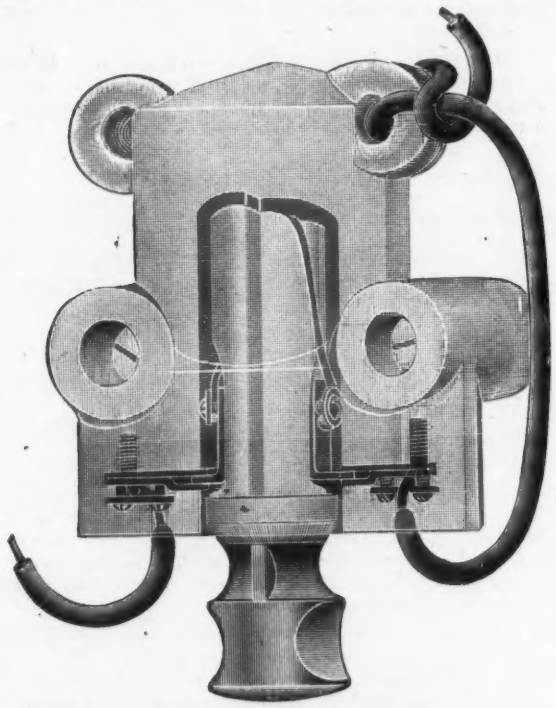
These voltmeters are listed in ranges from 12 to 700 volts, single and double scales, so that all classes of testing work are provided for.

All-China Junction Box and Motor Cut-Out.

The construction of a junction box or motor cut-out that would stand, without maintaining the arc between the terminals, such voltages as are in ordinary use has always been a difficult matter, and has heretofore met with but partial success.

A cut-out to meet the trying conditions of service on voltages from 500 up must be so constructed that the fuse chamber is surrounded by a material of very high insulating qualities, with opening merely large enough to permit the escape of the gases generated by the blowing of the fuse.

The junction box and motor cut-out illustrated herewith has been de-



Junction Box and Motor Cut-Out.

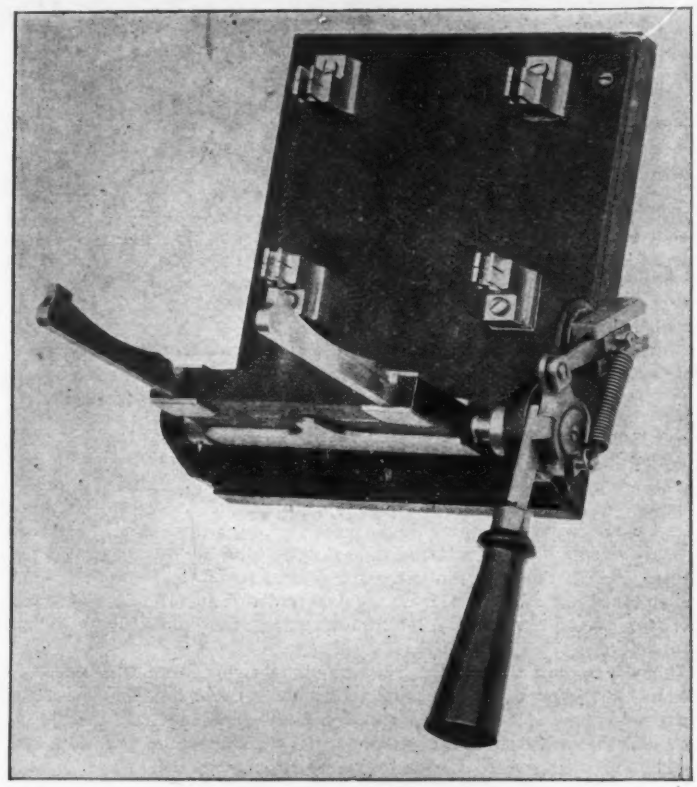
signed by Messrs. Pass & Seymour, Syracuse, N. Y., to meet conditions in high voltage work that heretofore have not been successfully met. The entire cut-out is constructed of porcelain. The plug, which will take a fuse five inches long, is held in the case by means of knife-contacts, and cannot drop out. The fuse chamber is completely divided by means of projections on the plug; this makes it necessary for the arc to travel the entire distance of five inches around the end of the plug, which would not happen with voltages ordinarily used. This device is suitable for use wherever a reliable cut-out is desirable.

An Instantaneous "Make and Break" Safety Knife Switch.

The Hope Electric Appliance Company, Providence, R. I., has just put on the market a very ingenious double pole knife switch, which is claimed to be the only instantaneous "make and break" knife switch now before the trade.

The style illustrated herewith is adapted to 500 volt circuits and has a rated carrying capacity of 50 amperes. The mechanism moving the switch consists of a link motion operated by a handle, which puts in tension a coiled steel spring connected to the axis on which the blades revolve. As soon as the spring is brought to the maximum tension, the slightest further movement of the handle starts the blades, and they are immediately thrown open. The same operation in a reverse direction instantly closes the switch. The action is positive and all four contacts are broken at exactly the same time. This is a very important feature. When the switch is in a normal position, either open or closed, the spring is under no tension whatever. If by any chance it should become broken, it does not destroy the quick "make and break" action.

The wearing parts are of drop forged steel having a machine finish. The blades, which are securely riveted to a block of fibre, are of the highest grade of rolled Lake Superior copper and the contact edges are carefully milled to size. The same metal is put in the brushes, which are of ample size to provide sufficient carrying capacity. Brass composition of the highest conductivity is used in the construction of the posts, that have milled slots into which the brushes are securely wedged and riveted.



Safety Knife Switch.

The switch is made with the utmost care in order to secure an easy working of the parts, and special attention is given to the accurate alignment of the blades and brushes. Since the switch is operated only by the action of the handle, it can be set in a sufficiently high position to prevent injury or an accidental short circuit of the blades and they can never be thrown out of line by careless handling. The position of the handle at the lower corner of the switch eliminates any danger to the operator, which is an especially desirable feature on high voltage circuits.

The Hope Electric Appliance Company has given special attention to standardizing all the parts. The switch is mounted on a marbleized slate base, and with the high polish presents a very pleasing and attractive appearance. It is made in sizes to carry 25, 50, 75 or 100 amperes for circuits of any voltage.

A Handy Drill Case.

A very handy appliance for every machine shop is illustrated herewith. It is, as will be seen, a case containing various receptacles for drills of all sizes. Of these receptacles there are 60. The No. 1 holds 16 drills and the No. 60 about 200. Each receptacle has on one of its divisions a memoran-

Drill Case.

dum of the sizes of the drills, given in decimals, also the exact size of drill to be used for all standard taps. Besides being a drill case it is, also, a drill gauge.

This useful case is manufactured and sold by Messrs. Weiss & Bros., 286–290 Graham Street, Brooklyn, N. Y.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 26, 1897.

ELECTRICAL STOCKS were weaker last week, all changes in quotations being downward, with the exception of New York Edison, which is 1 point higher. The changes in other stocks were fractional. General Electric was very steady in quotation all through the week. The total sales of this stock amounted to 7,105 shares. The sales of New York Edison bonds during the week were 10,000.

TELEGRAPH AND TELEPHONE.—Bell Telephone closed about 5 points lower than the previous week's closing quotation, and Commercial Cable is 10 points higher. Western Union is fractionally lower, but the rest of the list is about steady and unchanged.

ELECTRIC TRACTIONS were dull and practically unchanged. Brooklyn City Railroad stock, however, continues scarce, and the quotations are somewhat higher.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	106	110
Edison Electric Ill., Brooklyn	100	..	97
Edison Electric Ill., Boston	100	..	..
Edison Electric Ill , Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	19¼	19½
Electric Storage, pref	100	21	21½
General Electric	100	30⅝	31
General Electric, pref	100	71	72
Westinghouse Consolidated, com	50	..	24
Westinghouse Consolidated, pref	50	50	51
BONDS.			
Edison Electric Ill., New York, con. 5s	105	110½	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb 5s	100	96	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	220½	221
American District Telegraph	100	29	39
American Telegraph and Cable	100	87	88
Central and South American Telegraph	100	124	127
Commercial Cables	100	160	..
Erie Telephone	100	64	65
New England Telephone	100	..	102¼
Postal Telegraph Cable	100	96	98
Western Union Telegraph	100	79	79⅜
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	19¼	19⅝
Brooklyn Rapid Transit	..	20	21
Brooklyn Traction	100	..	14
Brooklyn Traction pref	100	46	48
Buffalo Street Railway	100	72	74
Cleveland Electric Railway	100	..	..
Columbus Street Railway	100	43	45
Hestonville	100	48	50
Hestonville, pref	..	..	62½
New Orleans Traction	100	4½	6
New Orleans Traction, pref	100	20	25
North Shore Traction	100	19	21
North Shore Traction, pref	100	76	78
Rochester Street Railway	..	12	15
Steinway Railway	..	45	50
Union Railway (Huckleberry)	..	98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	70½	71
West End, Boston, pref	100	91¼	92
Worcester Traction	100	17	19
Worcester Traction, pref	100	91	93
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	79½	..
Buffalo Street Railway 1st con. 5s	100	*106½	108½
Cleveland Electric Railway 1st mtge., 5s	100	103	105
*Columbus Street Railway 1st 5s	100	94	96
Rochester Street Railway 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge. 5s	..	105	107
*Westchester Electric 1st mtge. 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 29, 1897.

MR. A. A. THRESHER, of the Thresher Electric Company, Dayton, Ohio, was in New York during the week on business.

MR. JAMES L. GETHINS, electrical contractor, 181 Tremont Street, Boston, Mass., made a call on THE ELECTRICAL WORLD a few days ago.

MR. J. E. HAM, well known in the wire trade, has severed his connection with Mr. W. R. Brixey, of 203 Broadway, manufacturer of "Kerite."

H. B. COHO & CO., contractors for light, heat and power machinery, formerly at 203 Broadway, now occupy commodious offices on the fifteenth floor of the St. Paul Building.

MR. C. S. MENDEL, of the W. S. Hill Electric Company, New Bedford, Mass., has been in New York during the week calling upon the electrical supply houses. He reports that the switches and other goods manufactured by his company are finding a large sale in varous sections of the country.

THE MAGNETIC CLUB held its Spring dinner at the Tuxedo, Fifty-ninth Street and Madison Avenue, on the evening of April 24. There were about seventy-five members in attendance, and a general good time was had. President E. H. Johnson occupied the chair with his usual grace.

MR. ROBERT FESSENDEN, president of the Hope Electric Appliance Company, Providence, R. I., has been in New York several days on business connected with the manufactures of his company. He will open a New York office for the sale of the company's switches and other electrical specialties within a few weeks.

ELECTRIC STREET LIGHTING.—According to the report of the Commissioner of Public Works the total length of streets in New York City lighted by arc lamps is over 168 miles. Up to the present time 3,280 "dead" lamp-posts have been removed from the streets, and, the Commissioner reports, the work of removal will be continued until all have disappeared from Manhattan Island.

THE LEECOL STORAGE BATTERY COMPANY, 76-82 W. Jackson Street, Chicago, Ill., has just opened a New York office and shop at 275 Water Street, where, with ample floor space and technical facilities, it expects to meet the Eastern demand for Leecol storage batteries. The Lumino bicycle storage battery lamp made by this concern is already well known and in extensive use, but larger batteries are also being manufactured.

THE WALKER COMPANY'S NEW OFFICES.—The general sales office of the Walker Company has been removed to the new Gillinder Building, corner of Wall and Nassau Streets, New York. The Walker Company has taken an entire floor of the new building. Increased business has necessitated these large and more centrally located quarters. Mr. James W. Hinckley, who was recently elected president of the Walker Company, will hereafter have his office in the Gillinder Building, as will also Mr. H. McL. Harding, the general sales agent of the company, and his staff.

STANDARD AIR BRAKE COMPANY.—Mr. Edward H. Dewson, Jr., has become connected with the engineering staff of the Standard Air Brake Company, assuming his new duties on April 26. Mr. Dewson brings to the company a ripe experience, having been long and favorably known in connection with his work with the General Electric Company in its engineering department, and in connection with locomotive practice and the superintendency of one of the Western lines. He is thoroughly posted on the mechanical arts and will find full scope for his ability in his new field.

MR. LOUIS B. MARKS, inventor of the Pioneer arc lamp, who recently returned from Europe, is much gratified over the attentions bestowed upon him by well-known electrical engineers in France and England. Mr. Marks arranged for the exploitation of his lamp in both these countries. He also found when he got back to New York that the business of the American company, the Electric Arc Light Company, showed a rapid and steady increase, with a most promising outlook for the future. President Fred W. Marks and Manager J. H. Astruck were highly complimented by Mr. Marks on the success with which their efforts were meeting.

THE BI-CENTENNIAL OF TRINITY CHURCH will be celebrated during the week from May 2 to May 9. Very elaborate decorations are being prepared, and some $15,000 to $20,000 is being spent in order to appropriately commemorate the event. The decorations will consist of some figures which have been specially cast from designs of the famous artist, St. Gaudens, various banners and electrically lighted shields. A peculiarly novel effect is obtained by an electrical illumination of the figures, which are mounted about sixty feet above the floor of the church on a line with the pillars supporting the arches. The entire decorative work is under the supervision of Mr. H. Duckworth

Bayne, of H. D. Bayne & Co., 39 Cortlandt Street, New York. The electrical features will include some 200 incandescent lamps and quite an extensive temporary wiring installation.

THE E. S. GREELEY & CO., the old and well-known electrical supply house, at 5 and 7 Dey Street, New York, has, after a long and honorable business career, ceased to exist. The entire stock of goods was sold off at auction last week, and the place is now closed up. The business was established thirty-two years ago (in 1865), under the name of L. G. Tillotson & Co., of which firm General E. S. Greeley was a member from the very beginning. On the death of Mr. Tillotson, General Greeley took charge of the business and reorganized it under the name of The E. S. Greeley & Co., under which title it became widely known, and its goods were sent to all parts of the world. The company went into the hands of receivers on October 7, 1896, since which time the business has been gradually closed up, the final act taking place when the remaining stock was sold out at auction on April 19 last. General Greeley continues to maintain an office in the old building.

THE GORDON-BURNHAM BATTERY COMPANY.—Mr. A. S. Pinkham has purchased the interest of Mr. F. A. Burnham in the Gordon-Burnham Battery Company, 82 to 86 West Broadway, New York, and has assumed the position of general manager of the company. Mr. Burnham has also resigned as a director of the company. Mr. Charles E. Lockwood has been elected secretary and treasurer of the company. Arrangements are being made for an extensive laboratory to enable the company to develop several branches of work in connection with the Gordon-Burnham battery. Mr. L. C. Breyfogle has succeeded Mr. R. C. Gordon as general sales agent. Mr. Gordon will retain the office of vice-president, however. Mr. Lockwood, the new secretary and treasurer, is an old electrical man, and was formerly connected with the Lord Electric Company, Boston, Mass. Mr. W. C. Banks continues in the position of electrician for the company. General Manager Pinkham is well known in the electrical trade in New York City, and his large business experience fits him for his new duties. He was formerly superintendent of the Madison Square district of the Standard Gas Light Company, and was also connected at one time with the Lamson Consolidated Store Service Company, Boston.

AN IMPORTANT TELEGRAPH DEAL.—It is announced that the Postal Telegraph-Cable Company has signed contracts with the Mexican National and Mexican Central Railways, giving the Postal Company a strong foothold in Mexico, and a large share in the business to and from that country. Heretofore, in sending messages from Mexico to points in the United States, it had been necessary to transmit them in a roundabout way. Under the contract there will be a direct overland system between points in Mexico and Postal Telegraph stations in the United States, including every important town and city. Messages from Europe, it is stated, will pass by way of New York, over the cables of the Commercial Cable Company, thus making a complete chain of communication between Mexico and Europe. The telegraphic system controlled by the Mexican National and Mexican Central Railways comprises more than 3,000 miles of wire, covering the entire Republic. Lines are to be constructed from San Antonio, Texas, to Laredo, Mexico, and from Albuquerque, N .M., to El Paso, Mexico, and when these are completed, which it is expected will be within a few months, direct communication between the Mexican capital and New York will be established. The contract, it is stated, covers a period of twenty-five years, and is based upon mutual interest.

THE GRANT MEMORIAL PARADE.—The monster parade in celebration of the Grant Monument dedication, on Tuesday, April 27, was probably one of the largest this city has ever seen. Not only was the marching multitude stupendous and the line of march one of the longest of its kind, but the crowd assembled along the route and at the monument to view the paraders was equally immense, notwithstanding the inclement weather. Probably one of the most remarkable features of this great demonstration was the excellent arrangement made for handling this immense army of peace and the great crowds assembled to watch it. The general police arrangements were worthy of the highest praise, and accidents were remarkably few. By no means the least important feature of the arrangement was the electrical signaling systems installed along the line of the parade. Perhaps the most important of these was the very complete telephone system, which was under the direct supervision of the Police Department, and installed by Mr. R. Brennan, the superintendent of the police telegraph system in this city. Telephone booths, which were in fact temporary police stations, were erected along the route, approximately ten blocks apart. Three telephone stations were also on the river front. All of these stations were equipped with telephone instruments and were connected with one another and with police headquarters. Chief Conlin remained at headquarters and controlled the entire movement of his force from there by communication with his deputy at the tomb, or with any of the various stations along the line. Over 1,000 orders were given and received. Each of the stations was provided with an ambulance service and police-patrol wagon, and was in charge of an inspector and captain of police. The excellent service rendered by the police is probably due to this system of intercommunication, which permitted almost instantaneous communication between the chief of police and the lowest subordinate, and vice versa. The wires for the police telephone signaling system were run principally over house tops, many of the present wires on the line being also made use of and looped in circuit. The Fire Department also provided additional signaling facilities, and stationed at various points along the line specially detailed men to signal from the standard fire-alarm boxes. In the vicinity of the tomb five special fire-alarm boxes were installed. These were looped in on the regular system and given special numbers. In the Fire Department brigade of the parade were also two operators, who were detailed to transmit signals from the various boxes along the route to the Fire Department headquarters as the brigade advanced. Gen. Eckert, of the Western Union Telegraph Company, also afforded every facility for rapid intercommunication to the military section of the parade by means of a temporary telegraph service along the line of march. Nine stations were located at intervals between the police stations. These were connected by an ordinary Morse telegraph line with one another and without question performed a most important function.

New England Notes.

Branch Office of The Electrical World,
Room 91, Hathaway Building, 620 Atlantic Ave.,
Boston, Mass., April 27, 1897.

MR. W. W. BEAL, of the Mason Regulator Company, Boston, is proving himself a most capable and efficient official in the management of this company's already large and growing business. Mr. Beal has been connected with the company for a number of years.

MATHER APPARATUS.—A Mather lighting plant has just been installed at the Crescent Iron Works, Max Meadows, Va., to light the works and the town. The dynamo is also to furnish current for the Summer hotel there. In the same region are several successful coal mining plants, operated by Mather generators.

MESSRS. L. A. CHASE & CO., Inc., Boston, have accepted the sole agency for the Elden alternating machine circuit breaker, which has been subjected to most exacting tests, particularly by the Boston Electric Light Company, where it has been in use over two years, commanding an unqualified endorsement from President Gilbert as to its excellent merits and value. Several of these machines have been sold recently and are giving excellent satisfaction. This circuit breaker was recently illustrated in The Electrical World. It is standardized for all T.-H., General Electric, Westinghouse, Stanley and Fort Wayne alternators, whether single-phase, two-phase or monocyclic, and it will be adapted to any make of alternator on receipt of order.

JUDGE F. D. ELY has filed his report on the gas explosion at the corner of Tremont and Boylston Streets, Boston, March 4. The inquest was held to ascertain the cause of the death of William A. Start, and Judge Ely condemns the Boston Gaslight Company in these words: "In my judgment, the facts hereinbefore stated require me to find, and I do find, that the negligence of the Boston Gas Light Company is gross and inexcusable. I therefore find that the death of said William A. Start resulted from the unlawful act of the Gas Light Company." This statement is made by His Honor after a careful and complete review of all of the evidence brought out at the inquest. The Metropolitan Construction Company is absolved from all blame, but the Judge finds reason to censure the gas company for its action regarding the re-location of the gas pipes.

MESSRS. TABER & MAYER, manufacturers of telephones and switchboards, are making an addition to their already very complete factory at 185 Franklin Street, Boston. Beside the usual equipment of machinery for punching out, finishing and polishing the various parts, the company is installing an outfit for nickel plating. In the manufacture of induction coils special attention is paid to uniformity of resistance. The wire for the secondary winding is run through a special measuring device which insures accuracy. One of the most important specialties is the 80-ohm tubular drop, in which are combined a very quick action, together with compactness, two very desirable features. The company also manufactures its own watch-case receivers and granular carbon transmitters, which are giving a great deal of satisfaction. The factory of the Wakefield Rattan Company, Wakefield, Mass., has just been equipped by Taber & Mayer with its intercommunicating system. There are twenty-two stations on the line, each of which is provided with a magneto set.

Buffalo and Niagara Falls Notes.

Buffalo, N. Y., April 26, 1897.

TO EXTEND ITS ROAD.—The stockholders of the Olean Electric Street Railway, Olean, N. Y., have voted to increase the capital stock of the company to $300,000. The road will be immediately extended to Portville, six miles from Olean. This action on the part of the company has been long anticipated by the residents of both places.

BUILT A TROLLEY LINE IN ONE NIGHT.—Mr. Geo. P. Smith, the Tonawanda trolley man, stole a march on the Buffalo, Niagara River & Grand Island Railway Company, which was incorporated at Albany, April 12, to construct an electric street railway along O'Neil Street, at the Buffalo City Line, and to extend along the river road to the Grand Island Ferry. Smith and a gang of men went to O'Neil Street a few nights ago, without notifying any person, and laid his tracks through that street. The men went to work, and in five hours the job was completed. Thirteen hundred feet of tracks had been laid the entire length of O'Neil Street, extending from Tonawanda Street to the river road. Smith's line from Tonawanda connects with the new extension at Tonawanda Street.

CANADIAN EXTENSION OF FRANCHISE.—Secretary William B. Rankine, of the Cataract Construction Company, has returned to the Falls. He was seen at the Prospect House and was asked what he had learned in regard to the application of the Niagara Falls Power Company for an extension of time in which to begin developments on the Canadian side. Mr. Rankine said that he had an interview with Premier Hardy, but was unable to get any definite information as to whether the application would be granted or not. From what he heard he judged that some official statements that the extension was sure to be granted were regarded in Toronto as premature. It seems that the people in Canada who have been opposing the extension and trying to get privileges themselves have been very active. Mr. Rankine says that they represented to the Government that they would deposit $25,000 at once and expend $1,000,000 in development in a year's time. These parties assume to represent the Mannsmans, who have been much in evidence in the Lockport power canal talk, but who are not known to have carried out any scheme of that kind anywhere.

PITTSBURG NOTES.

PITTSBURG, Pa., April 26, 1897.

DIVIDEND DECLARED.—The Consolidated Traction Company has declared a dividend of 3 per cent. on its preferred stock. This is the first dividend distributed by the company, which has been in operation about a year.

TROLLEY MAIL ROUTE.—The citizens of Hollidaysburg, Pa., have petitioned the Postmaster General to establish a mail route on the Altoona & Logan Valley Electric Railway line between Altoona and Hollidaysburg. A change in the schedule on the Pennsylvania Railroad has deprived Hollidaysburg of its usual mail facilities. It is understood that the petition will be granted.

FESSENDEN MANUFACTURING COMPANY CHARTERED.—A charter was granted at Harrisburg on April 22 to the Fessenden Manufacturing Company, Pittsburg, with a capital stock of $100,000. The company was organized by Professor Reginald A. Fessenden, of the Western University of Pennsylvania. The other directors are J. G. Wainwright, D. N. Seely, F. H. Seely, Norman S. Tener and John F. Tener. The company proposes to manufacture under patents granted to Professor Fessenden a new form of long-burning arc lamp. It will also bring out a line of Röntgen ray apparatus, for which is claimed great simplicity, and a manufacturing cost so low that there will be no excuse for any ordinary physician to be without the appliances required for Röntgen ray explorations. The factory of the company will be located in the Imperial power building, corner of Penn Avenue and Third Street, Pittsburg.

BONUS OFFERED FOR STREET CAR SERVICE.—The property owners in the Squirrel Hill district are desirous of making their property more accessible from the city. This territory is now traversed by the Homestead and Highlands Company's tracks, but these terminate at the corner of Forbes and Boquet Streets, and an additional fare is required on the lines of the Consolidated Traction Company from passengers wishing to go into the city. Several meetings have been held, and finally a proposition was made to Mr. C. L. Magee, president of the Consolidated Traction Company, which he intimated would doubtless be accepted by his company. The recently issued charter of the Beechwood Traction Company is to be turned over to the Consolidated Company, together with a cash bonus of $50,000, of which amount about $35,000 has already been subscribed by the interested property holders. The Consolidated Traction Company in return is to build a double track road over the route described in the Beechwood Company's charter, and is to run cars on the same schedule as exists on the Highland Avenue line. The equipment, service and accommodations to the public are to be maintained at a standard equal to that of any other part of the company's system, and the fare to the city from any point on the line is not to exceed 5 cents.

ST. LOUIS NOTES.

ST. LOUIS, MO., April 26, 1897.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, Mo., has recently made the final shipment of telephones and apparatus to complete the exchange now in course of construction at Valley City, N. Dak.

UNDER ONE MANAGEMENT.—Edwards Whitaker and C. D. McLure were elected president and vice-president respectively of the Missouri Railway system last week in the reorganization of the road. These gentlemen also hold the same positions in the Lindell Railway system. The roads are therefore under one management.

BIG COMBINE.—A big combination between high tension companies in St. Louis has, it is stated, either been or is on the point of being effected. The parties to the reported combination are the St. Louis, the Edison and the Missouri, and the purpose is the securing of the city lighting contract, which is soon to be let, and the cheapening of the expenses of operating the plants.

CITY LIGHTING.—The Board of Public Improvements, not having received any bids for lighting the city under the old proposition, will submit a new ordinance to the Municipal Assembly to provide for a new letting. One of the proposed plans to light the city contemplates the erection of a lighting plant by a contractor, who is to be paid an annual rental for twenty years for the use of the plant. The contractor is to receive a yearly rental which shall earn him from 4 to 6 per cent. on his investment. At the end of twenty years the city is to have the option of buying the plant at an assessed valuation, the money paid in yearly rentals to be applied to the purchase price of the plant. The advertisements for gas and electricity allow the successful contractor to engage in private or commercial lighting, and in the case of electricity exempts him from paying into the city treasury 5 per cent. of the gross receipts. The ordinance will probably reach the Assembly this week.

CANADIAN NOTES.

OTTAWA, Can., April 26, 1897.

TO SUBSTITUTE ELECTRIC POWER.—The City Council of Hamilton, Ont., has been asked to pass a by-law granting the Hamilton & Dundas Railway permission to convert the line into a trolley system.

ELECTRICITY IN MINING OPERATIONS.—Arrangements are on foot to apply electric power to drills in several of the gold mines in Halifax County, Nova Scotia, and to do crushing and pumping by electricity also.

TORONTO, Ont., April 28, 1897.

NEW ELECTRIC ROAD.—There is a strong likelihood of the success of the project for an electric railway from Hamilton, Ont., to Beamsville, and Mr. J. S. Campbell, of Hamilton, was in this city recently trying to secure the aid of capitalists. He was fairly successful.

THE CATARACT POWER COMPANY, of De Cew's Falls, has petitioned the Hamilton (Ont.) City Council for a perpetual franchise to erect poles and string wires in that city. The company has secured a grant from the Government for water-power, and hopes within four months to be able to furnish electric power to manufacturers at a much lower rate than was charged at Niagara Falls, N. Y. The City Council and Board of Works is disposed to grant the franchise.

THE NEW CANADIAN TARIFF was put into effect last week, and a great many commodities entering into the electrical trade were affected. In the items enumerated below the initials "n. e. s." represent "not elsewhere specified," and "n. o. p." "not otherwise provided for." The articles enumerated on which the duty was changed or increased are as follows: Electric light carbons and carbon points of all kinds, n. e. s., 35 per cent. ad valorem; old, $2.50 per 1,000. Carbons, over six inches in circumference, 15 per cent. ad valorem. Chandeliers, gas, coal or other oil fixtures, and electric light fixtures, or metal parts thereof, including lava or other tip burners, collars, galleries, shades, and shade holders, 30 per cent. ad valorem; old, 27½ per cent. Glass bulbs for electric lights, 10 per cent. ad valorem. Wire, single or several, coated with cotton, linen, silk, rubber, or other material, including cable so covered, n.e.s., 25 per cent. ad valorem; old, 30 per cent. Wire of all metals and kinds, n.o.p., 25 per cent. ad valorem; old, 25 per cent. Railway cars (or other cars), wheel-barrows, trucks, road or railway scrapers, and hand carts, 30 per cent. ad valorem. The following articles were put upon the free list: Rubber and gutta percha, crude caoutchouc, or India rubber, unmanufactured; powdered rubber and rubber waste, hard rubber in sheets, but not further manufactured, and recovered rubber and rubber substitute. Rolled round wire rods in the coil, of iron or steel, under three-eighths of an inch in diameter, when imported by wire manufacturers for use in making wire in the coil in their own factories. Platinum wire and platinum in bars, strips, sheets, or plates, platinum retorts, pans, condensers, tubing, and pipe, when imported by manufacturers of sulphuric acid for use in their works in the manufacture or concentration of sulphuric acid. On the whole the changes are beneficial to the trade generally and ought to result in the introduction of more American-made goods.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, April 13, 1897.

INTERNATIONAL TELEPHONY.—Arrangements are now being completed for the laying across the English Channel of two additional two-circuit telephone cables. One will be manufactured, as usual, in England and laid by English hands, and the other will be dealt with by the French. When these cables are at work there will be six telephone circuits available between England and France, and with these additional circuits facilities for international telephony will be given to the large commercial centres both in England and in France, instead of confining them, as at present, to London and Paris only. When these new cables are laid there will be in all thirty-four telephonic and telegraphic circuits connecting England with France.

THE MANAGEMENT OF MUNICIPAL ELECTRIC LIGHTING CONCERNS BY GAS COMMITTEES.—In many cases, such as Manchester and Glasgow, the management of the municipal electric lighting undertaking by the Gas Committee has been followed by no untoward results. At the same time there are one or two flagrant instances of a Gas Committee opposing the development of electric lighting, and nowhere is there a more flagrant instance than at Salford, near Manchester, but I am glad to say that the scandal has become so great there that at its last meeting the Town Council decided by 33 votes to 8 votes to separate the two concerns, and to hand over the management of the electric lighting undertaking to an independent committee.

THE TRAMWAYS INSTITUTE OF GREAT BRITAIN AND IRELAND.—A meeting of the Tramways Institute of Great Britain and Ireland was held at Huddersfield on April 8, the delegates being entertained by the Corporation. This is the first occasion on which the Institute has been officially recognized by a municipal body, a fact which is significant of the threatened trend of tramway business in this country from limited liability companies to municipal authorities. The first paper dealt with this very subject, and was entitled "The Huddersfield Corporation Tramways and the Municipalization of Tramways." It was read by Mr. J. Pogson, the general manager of the steam tramways at Huddersfield. A lively discussion followed, in which all the delegates who took part displayed a decided bias toward the working of tramways by companies. Various objections to municipalization were brought forward, but perhaps the most important was that mentioned by the president, Mr. John. Fell, who stated that in his opinion the municipal working of the tramways had an unhealthy effect of giving the corporation undue control over a very large number of votes. It was also stated that at Huddersfield the corporation is paying a very much higher wage to its conductors and drivers than can be paid by companies. The second paper on the agenda described the Walker system of electric traction, and was read by Mr. Justus Eck, of Messrs. Lang, Wharton & Down. In this paper Mr. Eck described the details of the plant made by the Walker Company. At the conclusion of the meeting a visit was paid to the tramway depot, and a tour of inspection of the lines was made. One interesting feature in the Huddersfield cars is the provision of letter collecting boxes in each car. On the following day the delegates visited the experimental line at Prescot, where the simplex electric tramway conduit system is being exhibited.

General News.

THE TELEGRAPH AND TELEPHONE.

HURON, OHIO.—The Huron Telephone Company is extending its line to Sandusky, and the extension of the line eastward to Berlin and Ceylon is now under consideration.

WEST SUPERIOR, WIS.—A thirty-year franchise has been granted by the City Council to the new Peoples Telephone Company. The company, it is stated, will have long-distance connections, and competition will then exist.

WARREN, MICH.—It is reported that the new State Telephone Company, having secured several subscribers in this place, will extend its line to Warren at once. This will be the first telephone connection this place has ever had.

STILLWATER, MINN.—The Northwestern Telephone Exchange Company is about to extend its service in this vicinity, and will commence work immediately. A copper metallic line will be constructed to Hudson and thence to River Falls and New Richmond.

ABILENE, KAN.—A telephone system, one mile long, is now in operation between two farms, using barbed-wire fences for the lines. The wire, which is of the ordinary kind, is stapled to the posts. Where there are no posts the lines are carried across the spaces on poles.

BUSHNELL, IOWA.—There is every prospect that a telephone exchange will be established in this place. Three different companies are after the franchise, namely, the Central Union, the Western Illinois Telephone Company and the J. W. Thompson & Co., of Bedford, Ind. The latter propose, if the franchise is granted to them, to establish their plant for the manufacture of telephone appliances in Bushnell.

ELECTRIC LIGHT AND POWER.

YORK, PA.—Littestown is to have electric lights in a very short time.

CAREY, OHIO.—Carey and Nevada are talking of establishing electric light plants.

ROMEO, MICH.—In May the citizens will vote on the question of issuing electric light bonds.

GREENVILLE, ALA.—The Greenville Ice Company proposes to put in an electric plant for city lighting.

NEW LONDON, OHIO.—The citizens have voted to issue $8,000 in bonds for the purpose of putting in an electric plant.

EXETER, N. H.—A new power station and electric lighting plant will be erected half-way between Exeter and Hampton for the Exeter Street Railway Company.

THE ELECTRIC RAILWAY.

BURLINGTON, PA.—The trolley road between this city and Mount Holly is about to undergo a radical change of construction.

ASHTON, R. I.—There is some talk of a local company being organized to operate electric cars between Valley Falls and Ashton.

ITHACA, N. Y.—There is a probability of an electric road from Ithaca to Glenwood and Sheldrake, whence it will be likely continued to Ovid and Willard.

NEWBURYPORT, MASS.—It seems to be quite probable that the Plum Island road will be equipped with electricity, and that the road will be run to the beach front.

MONTICELLO, N. Y.—The State Railroad Commissioners have granted to the Monticello-Fallsburgh Railroad Company the right to build an electric road between the villages named.

NEW HAVEN, CONN.—The Milford Tramway Company has been granted leave by the Fairfield and New Haven County Commissioners to lay its rails across Washington Bridge, which spans the Housatonic River.

ANDOVER, MASS.—The Selectmen of this place will grant a public hearing in the near future on the petition of the Lawrence, Lowell & Haverhill Electric Railroad for the right to extend its tracks through West Andover.

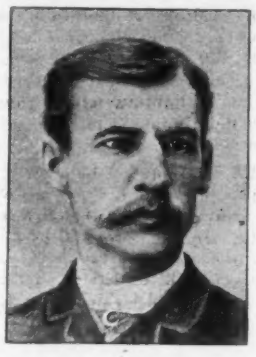
DOVER, DEL.—Mr. W. B. Welling, of New York, has asked the General Assembly to grant a charter to the Delaware Central Railroad to build a trolley road from Seaford to Rehoboth, a distance of thirty miles. The purpose of this line is to provide a connection with a line of steamships to carry produce from the Peninsula to New York.

PERSONAL NOTES.

MR. MAX LUHN, the director of the Helios Elektricitats Aktiengesellsschaft, has announced his betrothal to the daughter of H. Lindemann, the proprietor of the gas works at Schwerin. Mr. Luhn is well known in this country, and his many friends here, we are sure, unite with us in wishing the young couple a long, prosperous and happy wedded life.

MR. WM. M. BROOKE.—The many friends of Mr. Wm. M. Brooke, the popular representative in Texas of the Central Electric Company of Chicago, will be glad to learn that his genial qualities, as well as his attention to the wants of his customers, have been recognized in an unusual manner by the Texas Gas & Electric Light Association at its recent meeting in San Antonio, Texas. Mr. Goldrick, of the San Antonio Gas & Electric Light Company, on behalf of the Texas Gas & Electric Light Association, presented Mr. Brooke with a handsome gold medal, inscribed: "The most popular lighting man in Texas." Mr. Brooke's career in the electrical business began in the Fall of 1893, when he identified himself with the Central Electric Company in a subordinate capacity, the management of which was quick to recognize Mr. Brooke's qualifications. His progress, therefore, was very rapid, his experience as a salesmen in other lines being quickly adapted to the intricacies of the electrical supply trade. In 1894 Mr. Brooke was given full charge of the Southwestern territory, with headquarters in New Orleans.

MR. FRANK J. SPRAGUE, the prominent American electrical engineer and inventor, whose pioneer development of the electric railway and the electric elevator and successful exploitation of both have become electrical classics, is about to sail to Europe on various exceedingly important business matters. Mr. Sprague left on Thursday, April 29, sailing for London on the "Roumania." He intends to return in about four weeks. It is to be noted that during a very recent visit to Chicago Mr. Sprague secured the contract for the electrical equipment of the South Side Elevated Railroad with a new electrical traction system which is original with him. This contract was awarded notwithstanding the competition of all the prominent concerns who have developed this line of electrical application. The new system is on the same lines as the method experimented with by Mr. Sprague some eight or ten years ago on the New York Elevated Railway, and has been advocated by him ever since. It embodies a distribution of the motors to each individual car of the train, and the control of all motors from one central source. The return of this Nestor of the commercial electric railway to the field of his earliest and by no means least successful efforts certainly indicates many developments of interest to the electrical fraternity at large. Mr. Sprague will not abandon the development of the electric elevator, but will continue his relations with the Sprague Electric Elevator Company. Regarding the recent rumors of the probable consolidation of the Sprague Electric Elevator Company and the Interior Conduit & Insulation Company it appears that they are based on hearsay only. Inquiries among the most interested parties fail to indicate any such possibility.



FRANK J. SPRAGUE.

OBITUARY NOTE.

MR. WILLIAM B. SOMERVILLE, superintendent of the Press Bureau of the Western Union Telegraph Company, died at his home, Amsterdam Avenue and 153rd Street, New York City, on the evening of April 24. Mr. Somerville had been ill or several weeks with some kidney trouble, and he died after an operation, which it was thought would give him some relief.. Mr. Somerville was born in Toronto, Canada, on April 28, 1840, and became a telegraph operator. In April, 1862, he entered the United States Military Telegraph service, where he remained until the end of the war. In this service he was first an operator and cipher clerk, and afterward became acting aide on the staffs of Generals Hurlburt, Asboth, Granger, Thomas and McPherson. After the war he entered the service of the Western Union Telegraph Company at Louisville, Ky., and there became agent of the American Press Association. He afterward became general manager of the same association with headquarters in New York City, and fifteen years ago he re-entered the service of the Western Union Company as superintendent of the Press Bureau.

Trade and Industrial Notes.

THE STANLEY ELECTRIC MANUFACTURING COMPANY.—The Chicago office of the Stanley Electric Manufacturing Company, Pittsfield, Mass., has been removed from 305 Dearborn Street to 1506 Marquette Building.

THE ELECTRIC ENGINEERING & SUPPLY COMPANY, Syracuse, N .Y., calls the attention of the trade to the fact that it was the first concern to place "baby" switches on the market, and that it is still manufacturing these devices in very large quantities.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., is introducing a new electrical soldering iron, which it is ready to guarantee is an electrical and commercial success. It has given its new iron a very extensive test, and guarantees the best of results.

MESSRS. JAMES S. BARRON & CO., wholesale dealers in general electrical supplies, have moved into their new building at the corner of Hudson and Duane Streets, New York City. The offices of the electrical department, of which Mr. H. P. Copeland is manager, will be located on the second floor.

MR. J. WISTAR HUEY, electrical engineer and contractor, who has for the past two years been connected with the Union Traction Company, Philadelphia, has severed his connection with that company and has opened an office at No. 706 Girard Building, Philadelphia, Pa. Mr. Huey will make a specialty of lighting and railway work.

THE GENERAL ELECTRIC COMPANY has received an order for several hundred alternating current induction motors, to be used to operate the Tuerk ceiling fan, manufactured by the Hunter Fan & Motor Company, Fulton, N. Y. Hundreds of these motors were used last year for operating Tuerk ceiling fans, to the entire satisfaction of the Hunter Company.

MR. J. P. WILLIAMS, 39 Cortlandt Street, New York, is general agent for Mr. M. A. Knapp, 1515-1516 Monadnock Building, Chicago, manufacturer of a well-known type of Wheatstone bridge. This apparatus is convenient, light and portable, and is a practical instrument designed for practical men. The usual method of cutting in and out resistance by means of plugs has been sub-

stituted in this instrument by the more modern method of a contact arm sweeping over the terminals of the resistance coils, which terminals form an arc of a circle.

THE D. M. STEWARD MANUFACTURING COMPANY, Chattanooga, Tenn., reports that it is very busy just now, being full of orders in all lines of its well-known goods, including its lava electric insulators, which have met with such favor in the electrical field. The company has recently received quite a number of letters from Europe, requesting information in regard to its lava insulation. The lava insulators of this company have given such satisfaction that it always holds its old customers and is constantly gaining new ones.

BALL & WOOD ENGINES.—While there is still a disposition to practice great economy in station equipment, and managers are very slow to place new orders, yet there is more or less of this work commencing as Spring opens, and the Ball & Wood Company, 120 Liberty Street, New York, seems to be getting its share. Orders for two 200-hp tandem-compound engines for railroad work and one 150-hp simple engine for a lighting station have been entered this week for shipment to points in the United States, and another 200-hp tandem-compound for export.

THE CINCINNATI CORRUGATING COMPANY, Piqua, Ohio, has in press a treatise, to be issued in pamphlet form, upon the subject of galvanized iron and steel as roofing material. It will contain many important and interesting details on this subject, and a copy will be sent to anyone interested, on application. A few years ago there were not over a dozen iron roofing concerns in the country, where there are now hundreds of them. This rapid increase is due to the excellence and cheapness of iron for building material, and its lasting fireproof qualities. If an iron or steel roof is properly cared for and repainted, there is practically no limit to its life.

THE JEFFREY MANUFACTURING COMPANY, Columbus, Ohio, is out with its 1897 catalogue descriptive of chains and labor-saving devices. This catalogue is gotten up in handsome style, and is one of the most complete of its kind published. The first part is devoted to illustrations of this company's labor-saving appliances as applied to the various industries, while the balance of the book is devoted to the illustrating of its various chains, sprocket wheels, cable-conveyor fixtures, and general mill and factory supplies. It is a valuable reference book, and its price lists are such as will be of interest to all using labor-saving appliances. Copies can be had by addressing the company at Columbus, New York, Philadelphia, Buffalo, Chicago, St. Louis and Denver.

A LARGE CONTRACT.—The Card Electric Company, Mansfield, Ohio, informs us that it has been awarded the contract to furnish the entire electrical equipment for the new ship-building yards and establishment at Lorain, Ohio, of the Cleveland Ship Building Company. The apparatus called for in this contract consists of one 100-kw, 240-volt, direct-connected generator; one 40-kw, 240-volt, belted generator, and twenty-six motors in sizes varying from 2 to and including 40-hp. The motors are to be used in the various departments of the plant for driving machinery of different kinds. Two motors of 30-hp capacity will be used to operate two large bending rolls, and the total motor equipment will aggregate 500 horse-power. This is said to be the largest contract of the kind that has been given by one concern for a long time. In addition to this big contract the Card Company has recently closed others, as follows: One 30-kw direct-connected generator for the McGraw Buidling, Detroit, Mich.; one 50-kw direct-connected generator, Mechanical Rubber Company, Cleveland, Ohio; two 10-hp motors, with automatic controller for operating elevators, to the Edmonds Elevator Company, Cleveland, Ohio; one 100-kw direct-connected generator to the Ohio & Pennsylvania Coal Company, Salineville, Ohio; one 10-hp motor to M. A. Bradley, Cleveland, Ohio; two 10-hp motors to Wolverine Manufacturing Company, Detroit, Mich.; one 100-kw belt-driven generator, Monongah Coal & Coke Company, Monongah, W. Va.; one 65-kw belt-driven generator, Jeffrey Manufacturing Company, Columbus, Ohio; three 25-hp motors to H. J. Heinz Co., Allegheny, Pa.; one 11-kw belt-driven generator, Union City Ice Company, Union City, Tenn.; one 50-kw belt-driven generator and switchboard, Wm. Metcalf, Pittsburg, Pa.; one 20-hp motor, Mansfield News, Mansfield, Ohio; one 25-kw belt-driven generator, Oak Ridge Hotel, Green Springs, Ohio; one 10-hp motor, Stewart, Howe & May, Cleveland, Ohio; two 100-kw belt-driven generators, and one 67-hp and two 30-hp motors, to the Raton Coal & Coke Company, Raton, N. Mex.

Business Notice.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 19, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

580,851. MAGNETO TELEPHONE; L. E. Dye, Morris, Minnesota. App. filed May 27, 1896. In a magneto telephone the combination with the box and the diaphragm, of an upright permanent magnet supported within the box, a stationary bracket frame arranged above the magnet, extension pole-pieces adjustably secured at one end to the bracket-frame and fitting against the poles of the permanent magnet, induction helices or coils encircling the pole-pieces at one side of the permanent magnet, an armature connected with the diaphragm and disposed adjacent to the front ends of the pole pieces and balancing springs connected with the opposite ends of the armature.

580,853. TELEPHONE SWITCHBOARD; C. E. Eagan, Chicago, Ill. App. filed Dec. 5, 1896. The combination of a stationary jack, a pair of movable arms with their front ends projecting in front of the board in proximity to the jack or socket, and contact-points in the path of said arms, one contact point being in the circuit of the signaling apparatus and the other in the telephone circuit.

580,889. ARMATURE FOR DYNAMO ELECTRIC MACHINES; A. L Parcelle, Boston, Mass. App. filed Oct. 9, 1893. An armature for dynamo electric machines, consisting of a laminated core, a supporting frame which engages the periphery of the said core, and coils on said core, the portions of the periphery of said core between the engaging portions of the frame equaling in length the length of the inner circumference of the core, whereby the use of the wedges or blocks between the core is obviated.

580,911. SECTIONAL ARMATURE FOR DYNAMOS AND ELECTRIC MOTORS; G. L. Jeck, Nashville, Tenn. App. filed Jan. 9, 1897. An interchangeable armature for dynamos and motors, comprising a non-magnetic spider, washer, laminated core, binding posts and nuts, said washers and laminated core being formed with longitudinal aligned dovetail grooves in combination with an interchangeable armature-section formed with a longitudinal dovetail tongue adapted to be removably secured in the dovetail grooves.

580,927. FIRE ALARM SYSTEM; C. E. Buell, North Plainfield, N. J. App. filed April 29, 1884. A thermostat comprising a circuit controller that is held to close a circuit by a fusible substance, and when acted upon by heat, opens said circuit and then closes said circuit.

580,929. INTERLOCKING SWITCH FOR THEATRE DIMMERS; G. L. Colgate, Westfield, N. J. App. filed Nov. 16, 1896. The combination of a series of variable artificial resistances, a series of contact points for each resistance, a series of independently movable switch-arms, one for each resistance, a rotatable shaft upon which said series of switch-arms are mounted, and means at each switch-arm for locking and unlocking it with respect to said shaft.

580,931. ELECTRIC SELLING DEVICE; A. Davidson, New York, and C. G. Armstrong, Chicago, Ill. App. filed Jan. 25, 1896. A device for selling tickets at a number of different stations and automatically indicating to all the remote stations the sale of any ticket at any station comprising a series of stations each having an annunciator with individual ticket holders, a commutating device, and a common synchronizing mechanism, said stations being electrically connected for perfect synchronism between the commutators of said stations, and for reciprocal action between the annunciators and ticket-holders of the different stations.

580,951. AUTOMATIC CUT-OUT; C. A. Rolfe, Chicago, Ill. App. filed July 16, 1896. The combination of a cut-out device for removing the instrument from the line; means for connecting the line across the terminals of the instrument; and means operating upon an excess of current in the line for simultaneously operating both the cut-out device and the connecting means.

580,973. SWITCH AND SIGNAL APPARATUS; C. A. Geissenhainer, Pittsburg, Pa. App. filed May 25, 1896. In an apparatus for operating switches or signals, the combination of a longitudinally-movable rod, a rotatable sleeve engaging said screw, an electric motor on said sleeve, tripping mechanism for cutting off the current to said motor, and connections between said rod and said tripping mechanism.

580,987. OSCILLATING INTERRUPTER; D. McF. Moore, Newark, N. J. App. filed Dec. 3, 1895. The combination of an oscillatory or vibratory support, mechanism for imparting a vibratory motion to said support at a rapid and regular rate, and a circuit-interrupter mounted on said support and having one or more of its parts movable with relation to the support and adapted to produce a vibratory make and break of circuit at frequent regular intervals by the inertia or momentum of the movable parts of the interrupter.

580,988. INTERRUPTER; D. McF. Moore, Newark, N. J. App. filed Dec. 3, 1895. The combination with an interrupter working in a sealed receptacle, of an actuating magnet therefor and a source of alternating currents supplying said actuating magnet over a branch or circuit independent of that including the contacts of the interrupter.

581,023. SECTION INSULATOR FOR ELECTRIC RAILWAYS; S. L. Foster, San Francisco, Cal. App. filed Dec. 23, 1896. Section insulators and other devices of electric railways, interposed in the path of the trolley, said device having a terminal member to which the end of the trolley wire is connected, said member having an inclined plane adapted to gradually receive or part with the bearing of the flanges of the trolley wheel before or after said wheel leaves or comes to its bearing on the wire, according as the wheel is entering upon or leaving said terminal.

581,032. APPARATUS FOR SEPARATING PRECIOUS METALS FROM MAGNETIC ORES; C. F. Pike, Philadelphia, Pa. App. filed April 6, 1894. In combination, a body of mercury upon or over which ore is placed or caused to move, an electromagnet above said body of mercury, and electric circuits in which said magnets are situated.

581,034. PROCESS OF AND APPARATUS FOR SEPARATING PRECIOUS METALS FROM MAGNETIC ORES; C. F. Pike, Philadelphia,

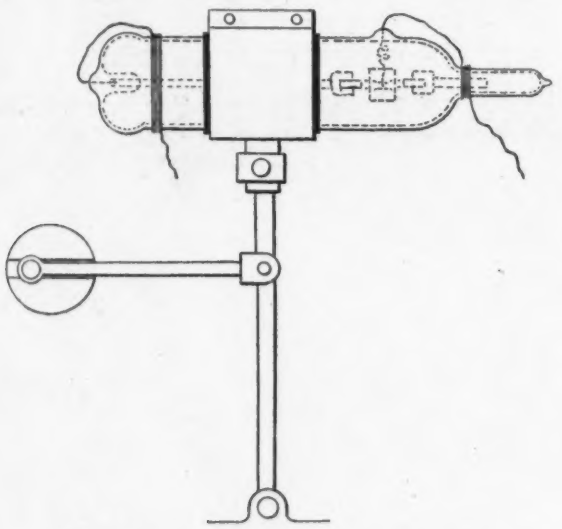
Pa. App. filed Oct. 21, 1896. A process of separating gold from magnetic ores, said process consisting in placing the ore above a bed of mercury, subjecting said ore to the influence of a magnetic field to draw said ore below the surface of the mercury, and then releasing the ore to permit the particles of ore to separate and rise through the mercury.

581,044. ANNUNCIATOR SIGNAL FOR TELEPHONE SYSTEMS: W. F. Smith, San Francisco, Cal. App. filed Aug. 4, 1894. A register mechanism for telephone lines comprising register wheels arranged behind a sight-opening at a switchboard, a rotating barrel carrying loose gears, one to each register-wheel, and connected to it by intermediate gearing, means for locking said loose gears separately and in successive order at the beginning of each rotative movement of the barrel and means for releasing said locked gear at the end of each rotative movement before the next one of said gears is locked; means actuated by pulsations of an electric current to rotate said barrel step by step a predetermined distance to set the register-wheels; and means for releasing said barrel at the end of each setting movement and a spring arranged to restore the barrel to its first position.

581,064. JUNCTION BOX COUPLING FOR ELECTRIC WIRE CONDUITS; J. P. Coghlin, Worcester, Mass. App. filed Feb. 8, 1897. The combination in a junction box for electric conduits, of a coupling for attaching the conduit thereto, consisting of a hollow coupling-bushing exteriorly screw-threaded, and interiorly smooth.

581,088. ELECTRIC WIRE INSULATOR; J. E. Sharpe, Oneida, N. Y. App. filed Feb. 8, 1897. An electric wire insulator consisting of a block of non-conducting material provided with parallel wire-receiving grooves respectively in its top and bottom and with channels at opposite sides of and at right angles to said grooves, for the reception of fastening devices by which to secure said block to its support.

581,089. DYNAMO ELECTRIC MACHINE; M. O. Southworth, Indianapolis, Ind. App. filed Sept. 22, 1896. The combination in a dynamo electric machine, of the frame thereof, field-coil cores and shoes therefor extending inwardly from said frame, the joints being formed by convex and concave surfaces struck from the axial line of the machine, said joints



No. 580,987. Oscillating Interrupter.

being located at a point intermediate the inner surface of the frame and the back sides of the shoes where it will be covered by the coils.

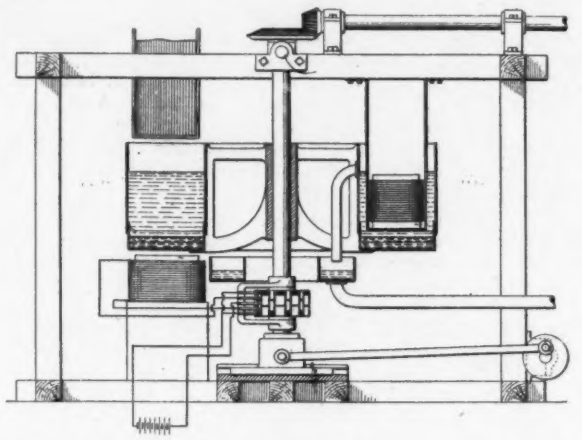
581,091. ELECTROMEDICAL APPARATUS; R. H. Wappler, New York, N. Y. App. filed Feb. 5, 1897. In an electromedical apparatus, the combination with a resistance-cylinder having a fine-wire surface winding, a dynamo or other source of electrical energy and wires therefrom to the winding of the cylinder to complete the main circuit, of an adjustable contact or terminal bearing upon the surface winding of the cylinder, a support therefor and one wire of a shunt-circuit therewith connected, a bar supported parallel with the surface of the resistance cylinder, and the other wire of the shunt-circuit therewith connected, a slide upon the bar and a contact bearing upon the surface of the cylinder and mechanism for reciprocating said slide and contact for varying the resistance in the shunt circuit.

581,101. MAGNET; G. G. Brown, Brooklyn, N. Y. App. filed April 7, 1896. In a magnetic ore separator, the combination of a chute having a compartment therein, said compartment being adapted to contain the flanges or shelves of magnetic pole-pieces, with the coils of a magnet having pole-pieces adapted to turn therein extending beyond the outer ends thereof, said pole pieces being provided with flanges or shelves projected laterally from the outer or free ends thereof, and having their inner ends adjustably connected with the armature, and means for adjusting said pole-pieces and flanges within said chute.

581,104. CONSTRUCTION OF BATTERIES; E. N. Dickerson, New York, N. Y. App. filed March 28, 1892. In a caseless battery the combination with plates respectively electropositive and electronegative to each other, each plate being provided with extensions, the extensions of the positive plates being at a different point from the extensions of the negative plates, of gaskets between said elements and extending around three edges of the plates, the outer frames, screw-rods connecting the frames for drawing the plates against the gaskets, and two of the rods connecting respectively with the extensions of the different plates.

581,129. ELECTRIC LIGHT AND HEAD GEAR FOR SURGICAL USE; L. W. Nevius, Chicago, Ill. App. filed March 20, 1896. In an incandescent lamp for surgeons, etc., the combination of an adjustable main band adapted to fit around the head, an adjustable supplementary band secured to the main band and adapted to be passed across the top of the head, a non-heat-conducting pad or pads secured to the main band, a base portion for holding the electric lamp, lugs by which the base portion is secured to the main band portion so as to provide an air space between such portions, a switch on the main band portion and a wire connecting the switch and lamp and adapted to connect the parts with a source of electrical energy.

581,135. TELEGRAPH KEY; M. M. Porter, Malone, N. Y. App. filed May 13, 1896. A telegraph key comprising a spring plate adapted for electrical connection with a line wire, a key lever, a finger piece of insulating material, a metal contact attached to said finger piece and having elec-



No. 581,034. Process of and Apparatus for Separating Precious Metals from Magnetic Ores.

trical connection with the key lever, a plate hinged to swing vertically on said finger-piece and a projection on said plate adapted to engage with the spring-plate to force it out of engagement with the contact on the finger-piece.

581,136. ELECTRIC ARC LAMP; W. L. Preece, Derby, England. App. filed July 7, 1896. A frictional grip for a rod or similar part comprising a hollow case surrounding the same and having an internal inclined face, a sleeve surrounding the rod or part within the case and provided with apertures, and a series of balls or rollers held in the apertures in the sleeve and bearing upon the rod or part and upon the inclined face of the case.

581,170. ELECTRICAL RESISTANCE-COIL; J. Nebel, London, England. App. filed June 12, 1895. The combination with a tube or casing of heat-conducting material, of a resistance coil supported therein and insulating granular material within said tube and surrounding said coil.

581,199. APPARATUS FOR UTILIZING ROENTGEN RAYS; C. F. Easton, Wallace, Idaho. App. filed June 1, 1896. An improved apparatus which consists of a lantern body or case, opaque to X-rays and having a front aperture, a fixed disc, whose central opening registers with such front aperture, a rotatable disc arranged parallel and adjacent to the fixed disc and provided with a series of graduated apertures which may be brought into coincidence with those in the fixed parts, a Crookes tube arranged within the case, a sliding carriage therefor and means for adjusting it.

581,204. ELECTRIC PUMP; B. Heftye, Tuxpan, Mexico. App. filed Oct. 10, 1896. In a magneto-electric pump, the combination with the pump-cylinders provided with induction and eduction valves and pipes are wound with motor-coils adapted to be connected with an electric generator, forming electromagnets, the opposite poles of which are in reverse directions, of connected pistons located in said cylinders wound with motor-coils adapted to be electrically connected with an electric generator and forming electromagnets independent of the cylinders and means for shifting the poles of said pistons.

No. 581,170. Electrical Resistance Coil.

581,242. ERECTING AERIAL ELECTRIC CABLES; F. S. Viele, Pittsburg, Pa. App. filed Nov. 13, 1896. An improvement in the art of erecting aerial cables, a method which consists in drawing the cable while supported from the message wire by temporary carriers to approximate final position, and then connecting the message wire and the cable by permanent supports while moving the cable to final position.

581,246. COMBINED TELEPHONE AND ELECTRIC LIGHT SYSTEM; C. E. Buell, North Plainfield, N. J. App. filed July 27, 1896. A series of lines radiating from an electric-lighting switchboard, a generator for charging said lines, connections from said lines to a telephone-switchboard, devices at subscribers' stations, for cutting off the charging current and connections from the several lines to apparatus for oral communication.